

11-5825-255-30

TM 11-5825-255-30

TECHNICAL MANUAL

DIRECT SUPPORT MAINTENANCE MANUAL
FOR

BEACON SETS, RADIO AN/TRN-30(V)1
(NSN 5825-00-405-4510)

AND

AN/TRN-30(V)2 (NSN 5825-00-423-1654)

HEADQUARTERS, DEPARTMENT OF THE ARMY
AUGUST 1977

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WARNING

The transmitter contains high voltages which can cause DEATH or injury if contacted. The RF meter on the front panel should not be relied upon to insure that high voltages are not present. Make sure that all power is turned OFF before any disassembly of the transmitter is performed. In addition, high voltage circuits should be grounded with a grounding probe to discharge capacitors.

WARNING

The amplifier contains high voltages which can cause DEATH or injury if contacted. The RF POWER meter on the front panel should not be relied upon to insure that high voltages are not present. Make sure that the POWER switch is set to OFF and that the power cable is disconnected before any further disassembly of the amplifier is attempted. In addition, dangerous potentials may exist from charged capacitors. To avoid electrical shock, discharge the high voltage circuits with a grounding probe.

WARNING

20,000 volts is present at the top of tuning coil 3A1A4. Do not touch the tuning coil during the following troubleshooting chart steps if power is applied to the amplifier.

WARNING

Do not touch antenna tuning coil 3A1A4 while power is applied during modulation adjustment. Severe injury or DEATH could result from extremely high RF voltage present on coil windings.

WARNING

Turn OFF all power to the transmitter before any disassembly procedure is performed.

WARNING

Turn OFF all power to the amplifier before any disassembly procedure is performed.

CHANGE }

No. 1 }

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC, 19 October 1983

Direct Support Maintenance Manual
BEACON SETS, RADIO AN/TRN-30(V)1
(NSN 5825-00-405-4510)
AND
AN/TRN-30(V)2 (NSN 5825-00-423-1654)

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1. New or revised material is indicated by a vertical bar in the margin.
2. Added or revised illustrations are indicated by a vertical bar opposite the identification number and title.
3. Remove old pages and insert new pages as follows:

<i>Remove pages</i>	<i>Insert pages</i>
i and ii.....	i and ii
1-1 and 1-2.....	1-1 and 1-2
3-3 and 3-4.....	3-3 and 3-4
3-7 and 3-8.....	3-7 and 3-8
3-27 through 3-30.....	3-27 through 3-30
3-37 and 3-38.....	3-37 and 3-38
None.....	3-38.1/(3-38.2 blank)
3-41 and 3-42.....	3-41 and 3-42
3-51 and 3-52.....	3-51 and 3-52.1
None.....	3-52.1/(3-52.2 blank)
3-57 and 3-58.....	3-57 and 3-58
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FO-11.....	FO-11
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REPORTING OF ERRORS AND RECOMMENDING IMPROVEMENTS
You can help improve this manual. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Mail your letter, DA Form 2028 (Recommended Changes to Publications and Blank Forms), or DA Form 2028-2 located in the back of this manual, direct to: Commander, US Army Communications-Electronics Command and Fort Monmouth, ATTN: DR-SEL-ME-MP Fort Monmouth, New Jersey 07703.
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CHAPTER 1

INTRODUCTION

Section 1. GENERAL

1-1. Scope

a. This manual describes the functioning of Beacon Set, Radio AN/TRN-30(V) (fig. 1-1) and provides direct support maintenance instructions. Included are instructions for testing, troubleshooting, adjusting, and removing and replacing parts in the radio beacon set.

b. The description of the radio beacon set and installation, operation, and organizational maintenance procedures are contained in TM 11-5825-255-12.

c. The lists of repair parts and special tools for direct support maintenance are contained in TM 11-5825-255-30P.

NOTE

For applicable forms and records, refer to TM 11-5825-255-12.

1-2. Consolidated Index of Army Publications and Blank Forms

Refer to the latest issue of DA Pam 310-1 to determine whether there are new editions, changes, or additional publications pertaining to the equipment.

1-3. Reporting Equipment Improvement Recommendations (EIR)

If your Beacon Set, Radio AN/TRN-30(V)1 or AN/

TRN-30(V)2 needs improvement, let us know. Send us an EIR. You, the user, are the only one who can tell us what you don't like about your equipment. Let us know why you don't like the design. Put it on an SF 368 (Quality Deficiency Report). Mail it to Commander, US Army Communications-Electronics Command and Fort Monmouth, ATTN: DR-SEL-ME-MP, Fort Monmouth, New Jersey 07703. We'll send you a reply.

1-4. Administrative Storage

Administrative storage of equipment issued to and used by Army activities shall be in accordance with TM 740-90-1.

1-5. Destruction of Army Electronics Materiel

Destruction of Army electronics materiel to prevent enemy use shall be in accordance with TM 750-244-2.

1-6. Calibration

No calibration of this equipment is required. However, adjustment procedures are contained in chapter 3.

Section II. DESCRIPTION AND DATA

1-7. Description

The general description and illustrations of the radio beacon set are in TM 11-5825-255-12.

1-8. Tabulated Data

Tabulated data such as weight, dimensions, power requirements, etc., are contained in TM 11-5825-255-12.

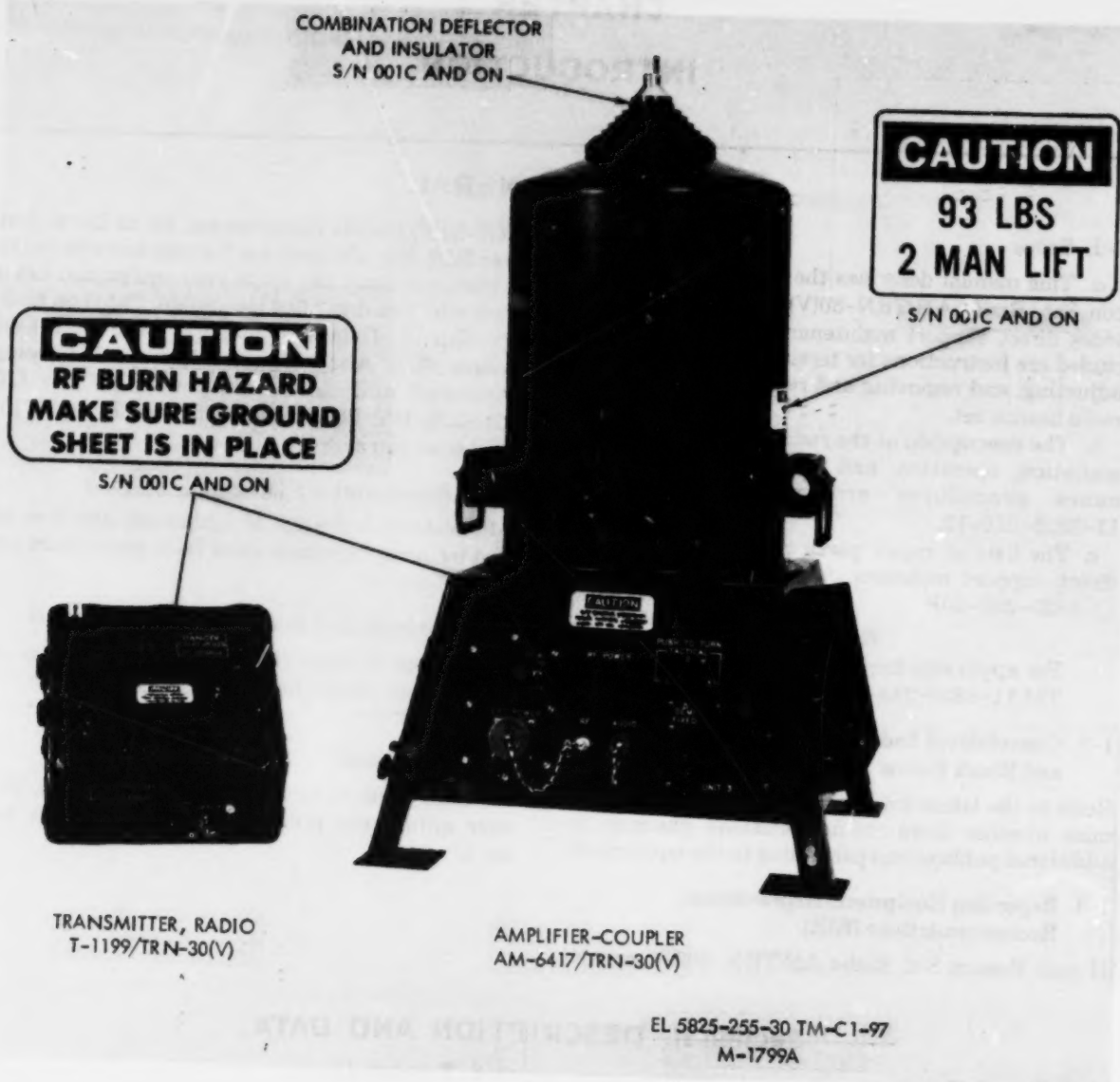


Figure 1-1. Beacon Set, Radio AN/TRN-30(V), Major Units.

CHAPTER 2

FUNCTIONING OF EQUIPMENT

Section I. TRANSMITTER

2-1. General

(fig. 2-1 and FO-2 and FO-3)

The transmitter is the operational control center of Beacon Set, Radio AN/TRN-30(V). In the pathfinder mode, the transmitter is used as a low power (28 watts), low to medium frequency, direction finding beacon. The frequency ranges are from 200.0 to 535.5 kHz and from 1605.0 to 1750.5 kHz. The types of transmission possible are up to four-letter combination Morse code identification signals or manually keyed transmissions on 964 channels.

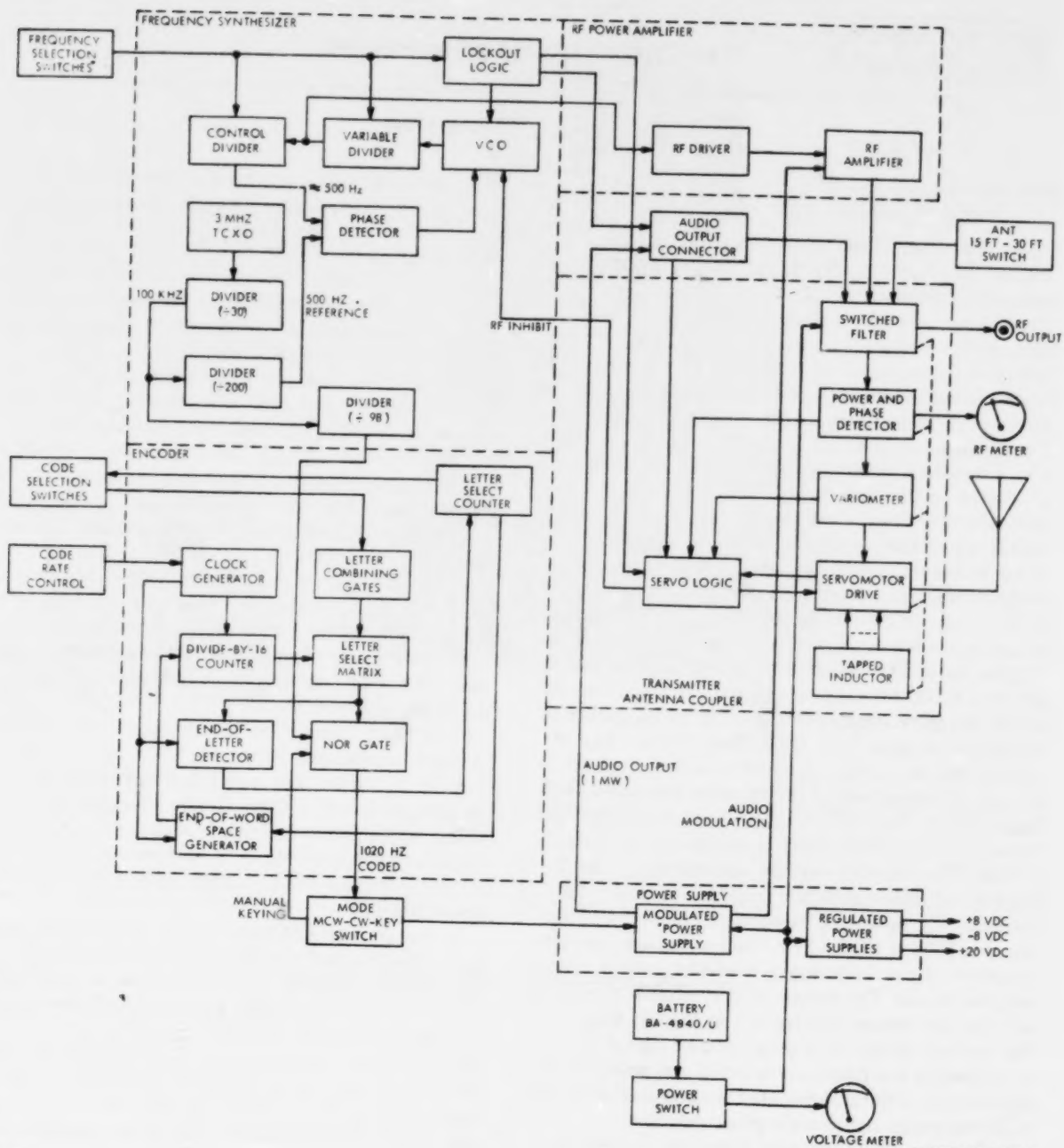
a. Frequency Synthesizer. The 964 channels are generated by dividing down the 3-MHz temperature-compensated crystal oscillator (TCXO) to obtain a reference signal that is applied to a discrete component phase locked loop controlled by the frequency selection switches and the variable divider. The output of the TCXO is divided by 30 to provide a 100 kHz signal, which is divided by 98 to produce the 1020 Hz identification tone. The 100 kHz is also divided by 200 to produce a 500 Hz reference signal for the phase detector. An approximate 500 Hz signal is also applied to the phase detector from the control divider. The two signals are compared to produce a stable dc voltage to control the frequency of the variable controlled oscillator (VCO). The VCO develops a carrier signal between 2.4 to 3.6 MHz which is applied to the variable divider. The variable divider, controlled by the frequency selection switches and the lockout logic, produces the operating frequencies of 200 to 535.5 kHz and 1605 to 1750.5 kHz. The lockout logic inhibits operation of the frequency synthesizer outside of the assigned bands. The output of the variable divider is fed into the control divider and to the RF amplifier. The control divider is a programmed digital divider controlled by the frequency selected and produces the approximate 500-Hz signal that is compared with the TCXO reference signal in the phase detector.

b. Encoder. A unijunction transistor is used as a variable free-running oscillator to make up the encoder clock. The clock regulates the letter sequence control and coding. The frequency of the oscillator is varied by the CODE RATE control to provide a Morse code rate of 7 to 20 words per minute. The output of the clock is fed through the divide-by-16 counter to control the

letter selection matrix output. The matrix sequentially interrogates the output from the letter combining gates, which are formed by the four-letter combinations set by the CODE selection switches and the letter select counter. The output of the matrix changes the binary data to a serial form for Morse code and feeds the coded data to a NOR gate and to the end-of-letter detector. The end-of-letter detector triggers the letter select counter when the serial data from the matrix indicates that the first letter has been interrogated and coded. The counter then selects the next letter to be coded. At the end of the fourth letter or space, a signal is applied from the letter select counter through the end of word space generator to reset the divide-by-16 counter and allow a time interval to pass before the entire cycle is started over. The NOR gate, turned on and off by the serial data from the matrix, gates the 1020 Hz identification tone from the synthesizer and applies the Morse coded signals to the modulated power supply. The 1020 Hz identification tone can also be manually gated through the NOR gate to key the transmitter.

c. Rf Power Amplifier. The rf signal from the synthesizer is processed in the rf driver by a phase inverting amplifier. The equal but oppositely phased signals are fed to a Class S low level push-pull amplifier which drives the class S high level push-pull rf amplifier. The rf amplifier is modulated by the 1020-Hz identification tone supplied from the modulated power supply.

d. Transmitter Antenna Coupler. In the pathfinder mode, the rf signal is applied to the switched filter in the antenna coupler. In the tactical or semi-fixed mode, the antenna coupler is disabled and the output is applied to the RF OUTPUT connector on the front panel. When a frequency is selected, digital data from the lockout logic (synthesizer) is applied to the servo logic circuitry. The data is converted into a dc voltage that starts the motor drive. The motor mechanically selects a bandpass filter in the switched filter which matches the output impedance of the power amplifier. When operating with the 15-foot antenna, the ANT switch selects the proper output impedance for the rf amplifier. The motor also drives a tapped inductor and variometer to match the capacitive reactance of the



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M-1700

Figure 2-1. Transmitter, Radio T-1199/TRN-30(V), Block Diagram.

antenna. When the motor starts, the rf signal is turned off and the motor runs at maximum speed until the correct filter is selected and the tapped inductor is switched to one of the several taps that correspond to the correct filter. The motor is then driven at a medium speed and a low power rf signal is applied through the filter to the detector. At the same time, the tapped inductor is switched from tap to tap and the variometer is driven to provide fine tuning for each tap selected. This cycle is repeated until the current through the detector exceeds a preset level reached when the antenna system nears resonance, indicating the correct inductor tap has been reached. The output of the detector then controls the motor drive, which drives the variometer at creep speed for final tuning. The rf signal, now at high power, is then fed to the antenna.

e. Power Supply. Primary dc input power from a battery or external source is converted into regulated voltages by four main power supplies. Steady-state power supplies provide +8 vdc, +8 vdc, and +20 vdc. A modulated power supply provides a modulated +10 vdc to the rf amplifier and a low level control signal to the antenna coupler via the audio output connector. The modulated power supply is modulated by the 1020-Hz identification tone and controlled by an inhibit command from the antenna coupler.

f. Antennas. In the pathfinder mode of operation, one of two antennas may be used. The 15-foot antenna uses inductive center loading and the 30-foot antenna uses capacitive top loading. Both antennas use the transmitter as a base and require guying and ground radials.

2-2. Frequency Synthesizer

(fig. 2-2)

The purpose of the frequency synthesizer is to generate transmitting frequencies in the 200- to 535.5-kHz and 1605- to 1750.5-kHz frequency bands, to generate the 1020-Hz identification tone, to generate the proper antenna coupler filter select signals, and to prevent selection of transmitting frequencies outside of the specified frequency bands. The transmitting frequencies are generated in 500-Hz increments within the two frequency bands, which consist of 672 channels in the lower band and 292 channels in the higher band for a total of 964 channels. These frequencies are amplified in the rf amplifier. The proper bandpass filter in the antenna coupler is selected by the filter select signals as logic inputs. The transmitting frequencies are generated by a VCO and a variable divider. The variable divider divides the output frequency of the VCO in ac-

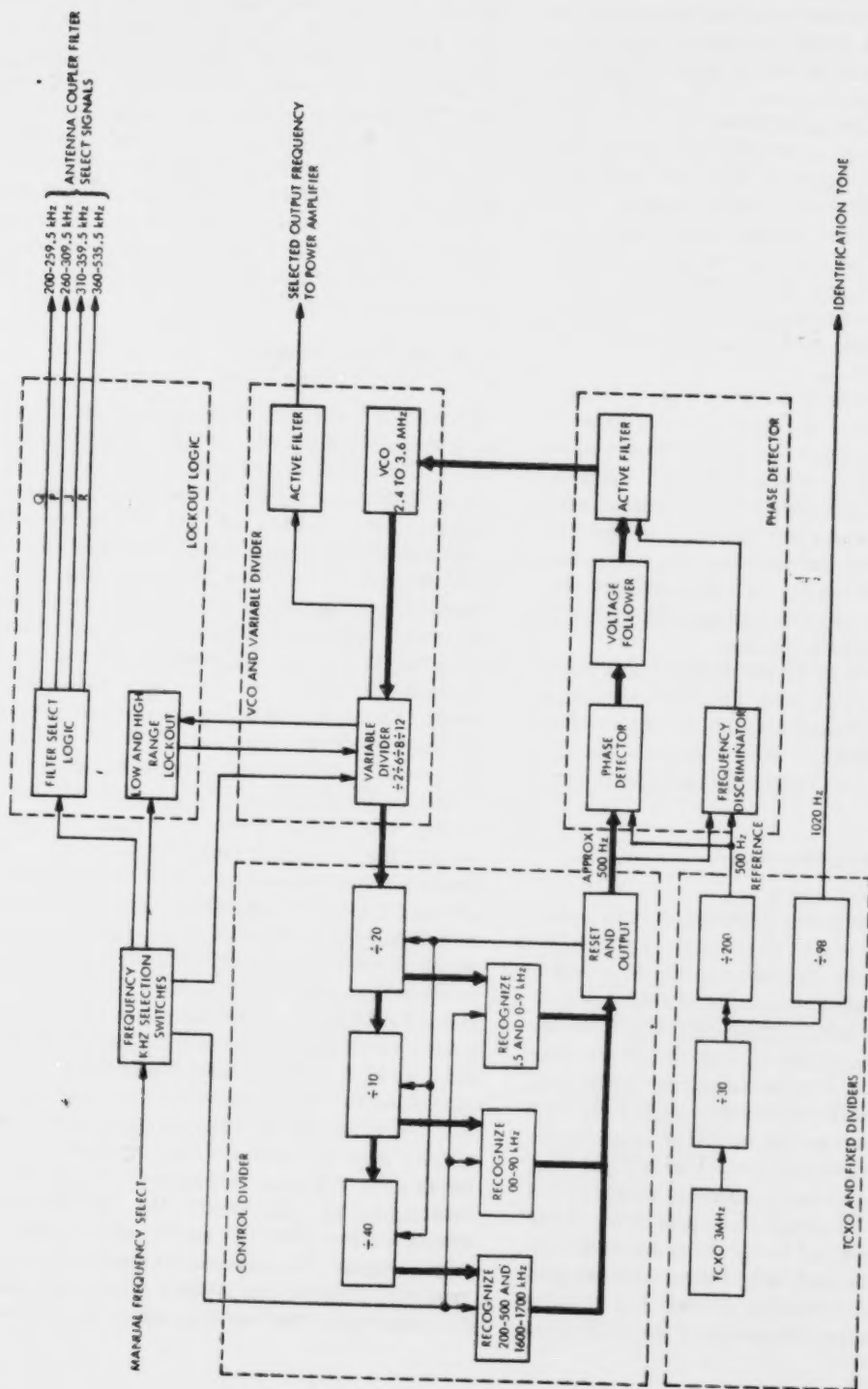
cordance with the settings of the frequency selection switches and divides the VCO output by 2, 6, 8, or 12 as required. The output of the variable divider is applied to the input of the control divider. The control divider operates at divide ratios of 400 to 3500 to produce an approximate 500-Hz signal for input to the phase detector. A reference frequency of 500 Hz and the 1020-Hz identification tone are generated by the TCXO and fixed dividers. The phase detector compares the approximate and reference 500-Hz signals and produces a correction voltage, which is applied to the VCO to phase lock the output frequency to the reference frequency. The following subparagraphs provide detailed descriptions of the individual circuits of the frequency synthesizer.

2-3. Lockout Logic

(fig. 2-3 and FO-4)

The lockout logic inhibits the generation of transmitting frequencies outside the two frequency bands of 200 to 535.5 kHz and 1605 to 1750.5 kHz. It also provides filter select signals to the antenna coupler. The lockout logic consists of the frequency selection switches and the lockout logic circuit card 1A8.

a. Frequency Selection Switches. The electromechanical configuration of the frequency selection switches inhibits the selection of some unwanted frequencies. This is accomplished by limiting the switch positions available on the most significant digit switch, the second most significant digit switch, and the least significant digit switch. The most significant digit switch, farthest left, only has switch positions of 1 and 0. This inhibits the selection of frequencies above 1999.5 kHz. The second most significant digit switch only has switch positions 0 through 7, further limiting frequency selection to 0000.0 through 799.5 kHz and 1000.0 through 1799.5 kHz. The least significant digit switch, farthest right, only has switch positions of 0 and 5, which inhibits selection of frequencies in other than 500-Hz increments. Additional frequencies are inhibited by processing switch signals. The frequency selection switches are designated, from left to right, as M, I, J, K, and 500 Hz select. Each switch has provisions for binary-coded decimal outputs of 1, 1*, 2, 2*, 4, 4*, 8, and 8*. (Signals designated with an asterisk (*) are the inverse of like signals without the asterisk.) For example, selection of a 1 on the second most significant digit switch, the I switch, produces a ground or low level I1* signal and an open or high level I1 signal. The common terminal of each switch is grounded. Table 2-1 provides a reference to signal levels produced by the frequency selection switches.



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M-1701

Figure 2-2. Frequency Synthesizer, Block Diagram.

Table 2-1. Frequency Selection Switches, Signal Levels

Switch pos.	MHz Select M	100's position				10's position				1's position				500 Hz select
		I4	I2	I1		J4	J1	J2	J1	K4	K4	K2	K1	
0	0	0	0	0		0	0	0	0	0	0	0	0	0
1	1	0	0	1		0	0	0	1	0	0	0	1	-
2	-	0	1	0		0	0	1	0	0	0	1	0	-
3	-	0	1	1		0	0	1	-	0	0	1	1	-
4	-	1	0	0		0	1	0	0	0	1	0	0	-
5	-	1	0	1		0	1	0	1	0	1	0	1	1
6	-	1	1	0		0	1	1	0	0	1	1	0	-
7	-	1	1	1		0	1	1	1	0	1	1	1	-
8	-	-	-	-		1	0	0	0	1	0	0	0	-
9	-	-	-	-		1	0	0	1	1	0	0	1	-

NOTE

-Indicates no switch position, 0 indicates low or short to ground, 1 indicates open or high signal.

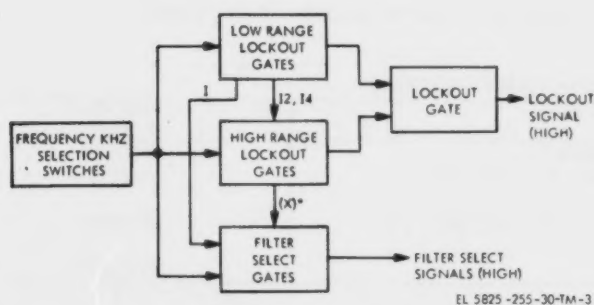
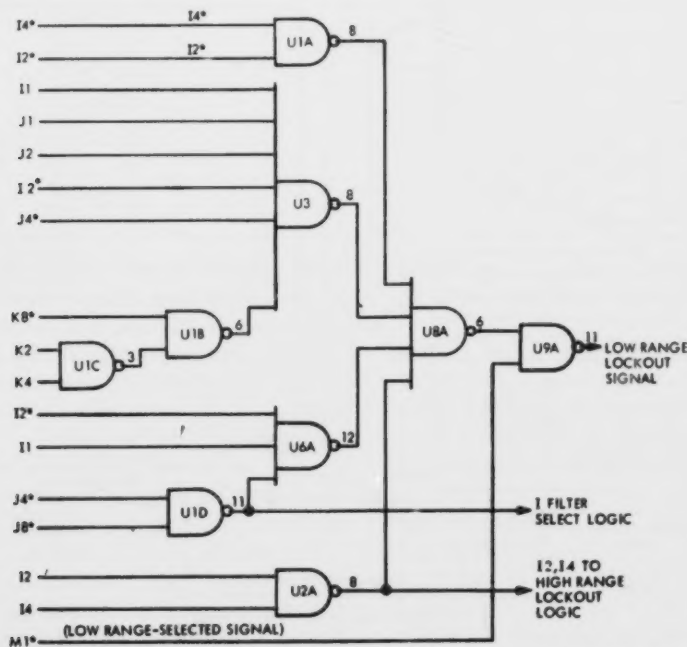


Figure 2-3. Lockout Logic, Block Diagram.

b. Low Range Frequency Inhibit Signals (fig. 2-4).

Frequencies in the 000 to 199.5 kHz range are inhibited by signals I2* and I14*, which are at a high level when the I switch is in positions 0 or 1. These two signals are NANDed to produce an inhibit signal at U1A pin 8. The logic for all the lockout gates is identical. They may be drawn differently to indicate functional use. Each NAND gate requires all high inputs to generate a low output. Each NOR gate requires all low inputs to generate a high output. A gate drawn as an OR gate with all inputs inverted, functions as a NAND gate. The other unwanted frequencies under 800.0 kHz are inhibited in a similar way. The frequencies inhibited, the switch position signals used to generate



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Figure 2-4. Low Range Lockout, Logic Diagram.

the inhibit signals, and the point the inhibit signal is present is listed in table 2-2. The four inhibit signals produced (table 2-2) are combined at U8A pin 6 and Nanded with the low range selected signal M1*, which is high when the M switch is in the 0 position.

The use, in U9A, of the low range-selected signal inhibits the generation of inhibit signals when selecting frequencies in the 1605 to 1750.5 kHz range. The low range lockout signal, a zero level, is produced at U9A pin 11.

Table 2-2. Low Range Frequency Inhibit Logic Signals

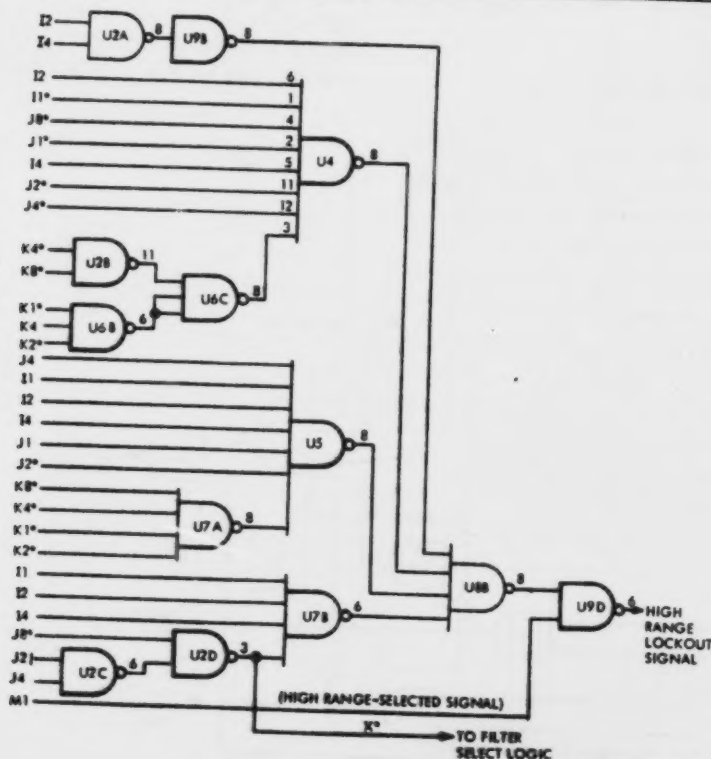
Frequency range inhibited	Signals used	Inhibit signal check point
000 to 199.5 kHz	I2*, I4*	U1A pin 8
536 to 539 kHz	I1, I2*, J1, J2, J4*, K2, K4, K8*	U3 pin 8
540 to 599.5 kHz	I1, I2*, J4*, J8*	U6A pin 12
600 to 799.5 kHz	I2, I4	U2A pin 8

c. *High Range Frequency Inhibit Signals* (fig. 2-5). The inhibit signals in the high range are generated in a way similar to the generation of the low range frequency inhibit signals. The signals used to generate the inhibit signals, and the point the inhibit signal is present, is listed in table 2-3. The inhibit signals produced (table 2-3) are combined at U8B pin 8 and

Nanded in U9D with the high range-selected signal M1, which is high when the M switch is in the 1 position. The use of the high-range selected signal inhibits the generation of inhibit signals when selecting frequencies in the 200 to 535.5 kHz range. The high range inhibit signal is produced at U9 pin 6.

Table 2-3. High Range Frequency Inhibit Logic Signals

Frequency range inhibited	Signals used	Inhibit signal check point
1000 to 1599.5 kHz	I2, I4 (U2 pin 8 inverted)	U9B pin 8
1600 to 1604.5 kHz	I1*, I2, I4, J1*, J2*, J4*, J8*, K1*, K2*, K4, K4*, K8*	U4 pin 8
1751 to 1759.5 kHz	I1, I2, I4, J1, J2*, J4, K1*, K2*, K4*, K8*	U5 pin 8
1760 to 1799.5 kHz	I1, I2, I4, J2, J4, J8*	U7B pin 6



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Figure 2-5. High Range Lockout, Logic Diagram.

d. *Filter Select Signals* (fig. 2-6). The filter select logic generates signals to select one of five filters in the transmitter or amplifier antenna coupler. The antenna coupler filter select signals are designated Q (200 to 259.5 kHz), P (260 to 309.5 kHz), J (310 to 359.5 kHz), and R (360 to 535.5 kHz). The proper fre-

quency range filter is selected by a high signal level at any one of the Q, P, J, or R outputs. The filter for the 1605 to 1750.5 kHz range is selected when the M signal from the servo logic is high. At this time the Q, P, J, R signals are low.

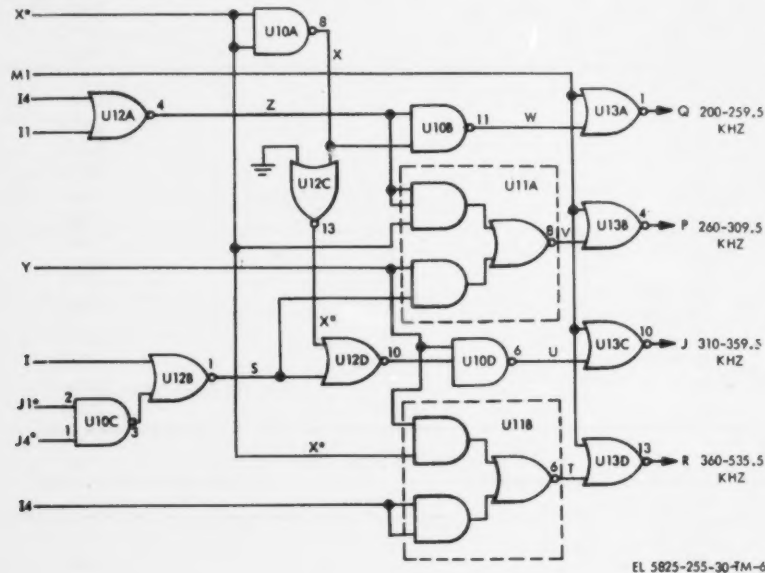


Figure 2-6. Filter Select, Logic Diagram.

Table 2-4. 200 to 259.5 kHz Filter Selection

Signals used	Level
J2, J4	Low
J8*	High
X*	Low
X	High
I1, I4	Low
Z	High
W	Low
M1	Low
Q	High

(1) The 200 to 259.5 kHz filter is selected when the M1 signal is low (M switch is in position 0), signals I1 and I4 are low (I switch is in position 2), and either J2 or J4 is low while J8* is high, represented by X* from figure 2-5 (J switch is in positions 0 through 5). The K switch signals are not used as all positions 0 through 9 are allowed. Table 2-4 lists the results of correct combinations of these signals.

(2) The 260 to 309.5 kHz filter is selected when the M1 signal is low (M switch is in position 0) and the following signals are applied: I1 and I4 are low (I switch is in position 2) and either J2 and J4 are high (J switch is in position 6 or 7) or J8* is low (J switch is in position 8 or 9); the Y signal from the VCO is high (I switch is in position 3), and J1*, J2*, J4*, and J8*, are high (J switch is in position 0). The I signal is gen-

erated by U1D, figure 2-4. Table 2-5 lists the results of correct combinations of these signals.

(3) The 310 to 359.5 kHz filter is selected when the M1 signal is low (M switch is in position 0), either J2 or J4 is low while J8* is high (J switch is in positions 0 through 5), and the Y signal from the VCO is high (I switch is in position 3). Table 2-6 lists the results of correct combinations of these signals.

(4) The 360 to 535.5 kHz filter is selected when the M1 signal is low (M switch is in position 0) and I4 is high (I switch is in positions 4 through 7), or J2 and J4 are high or J8* is low (J switch is in positions 6 through 9), and the Y signal from the VCO is high. Table 2-7 lists the results of correct combinations of these signals.

Table 2-5. 260 to 309.5 kHz Filter Selection

Signals used	Level
M1	Low
I1, I4	Low
Z	High
J2, J4	High
X*	High
V	Low
P	High
M1	Low
I1, I4	Low
Z	High
J8*	Low
X*	High
V	Low
P	High
M1	Low
Y	High
J1*, J2*	High
J4*, J8	High
I	Low
S	High
V	Low
P	High

Table 2-6. 310 to 359.5 kHz Filter Selection

Signals used	Level
J2, J4	Low
J8*	High
X	Low
X*	High
J1*, J4*	High or Low
I	Low or High
S	Low
Y	High
U	Low
M1	Low
J	High

Table 2-7. 360 to 535.5 kHz Filter Selection

Signals used	Level
Y	High
J2, J4	High
J8*	Low
X*	High
I4	High
T	Low
M1	Low
R	High

2-4. TCXO and Fixed Dividers

(fig. 2-7 and FO-5)

The TCXO and fixed dividers produce the reference 500-Hz signal used in the phase detector and the 1020-Hz identification tone used for transmission modulation. An integrated circuit voltage regulator is also included on the card to provide regulated +5 vdc to the fixed divider elements and to the TCXO. The +5 vdc from the regulator also ensures that the elements of

the fixed divider all start counting from the reset or cleared condition.

a. **TCXO.** The TCXO is a precision frequency reference source. It supplies 3.0 MHz $\pm$ 3 Hz over a -45°C to +85°C temperature range. The TCXO uses the regulated +5 vdc and +20 vdc as input power.

b. **Fixed Dividers** (fig. 2-8 through 2-11). The fixed dividers consist of three dividers, a divide-by-30 counter, a divide-by-200 counter, and a divide-by-98 count-

er. Each counter contains individual prime number counters as shown on figure 2-7. The flip-flop of each counter operates identically. A high logic level at the J or K inputs is required with the negative-going edge of the clock (ck) input to cause the flip-flop to change states.

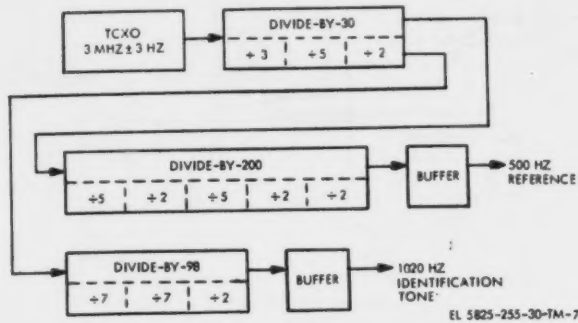


Figure 2-7. TCXO and Fixed Dividers, Block Diagram.

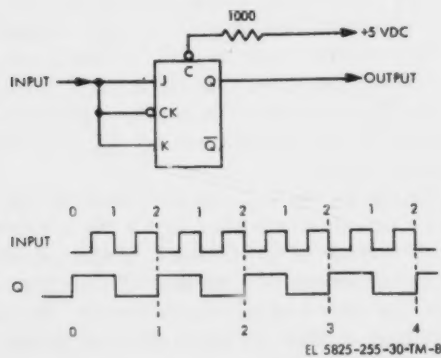


Figure 2-8. Divide-by-2 Counter and Waveforms.

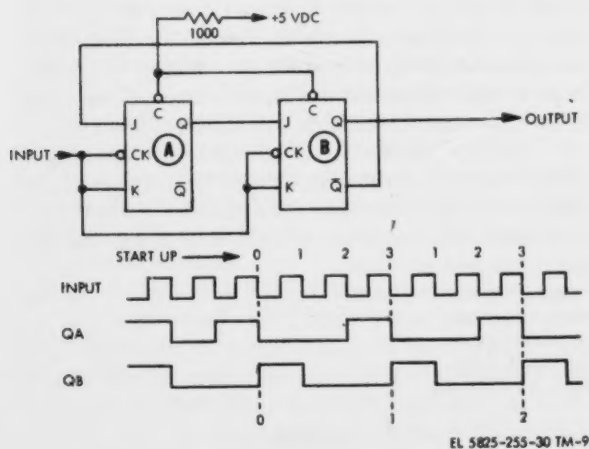


Figure 2-9. Divide-by-3 Counter and Waveforms.

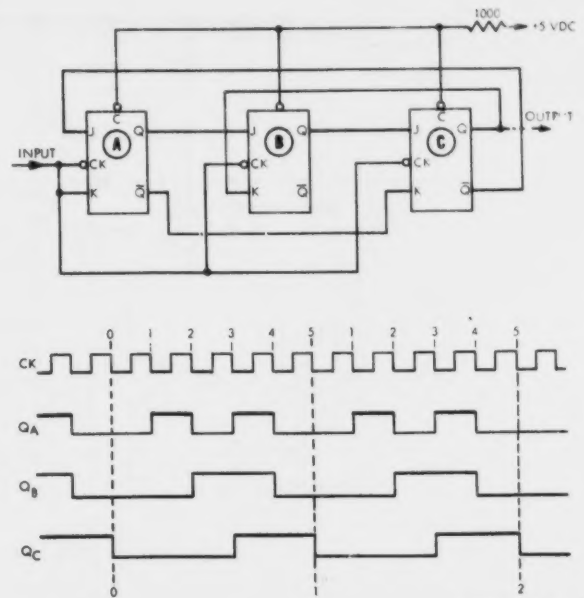


Figure 2-10. Divide-by-5 Counter and Waveforms.

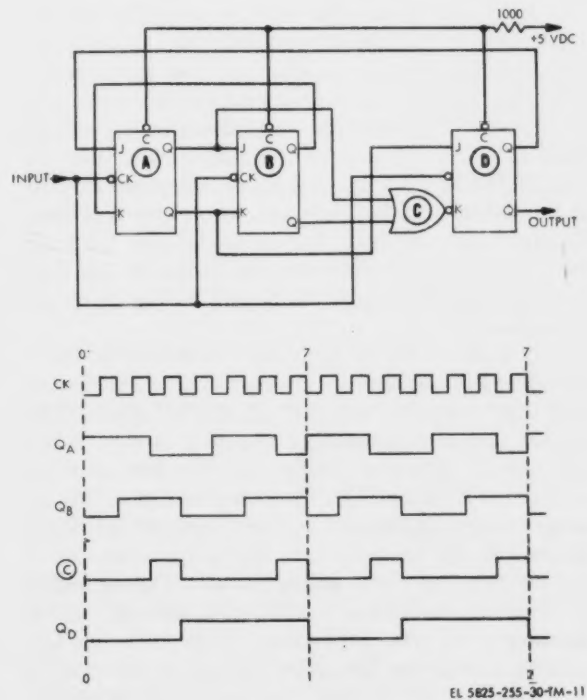
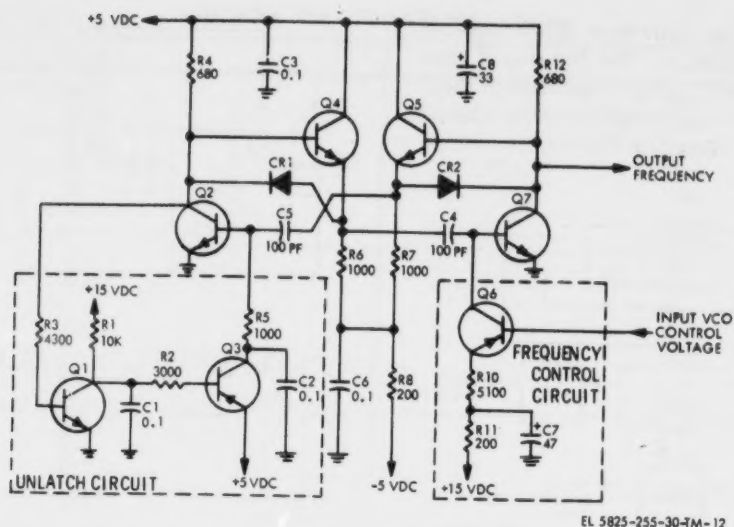


Figure 2-11. Divide-by-7 Counter and Waveforms.

2-5. VCO and Variable Divider (fig. FO-6)

The VCO consists of a voltage-controlled astable multi-vibrator, logic circuits that divide the output of the os-



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Figure 2-12. VCO, Functional Schematic Diagram.

cillator to generate frequencies in the bands required, an output buffer, and three voltage regulators. The output frequency is determined by the divider selected and the correction voltage from the phase detector.

a. *VCO* (fig. 2-12). The voltage-controlled astable multivibrator consists of transistors Q1 through Q7 with the necessary decoupling and bias components. Transistors Q2 and Q7 are the primary components in the circuit. Transistors Q4 and Q5 are active pull-up loads to speed charging of the timing capacitors C4 and C5. Diodes CR1 and CR2 act as high speed current paths to discharge the timing capacitors when Q7 and Q2 alternately conduct. Transistors Q1 and Q3 form the unlatch circuit. Transistor Q6 is the voltage control amplifier that varies the output frequency of the multivibrator.

(1) *Unlatch circuit*. Since the component values of the Q2 and Q7 circuits are the same, the multivibrator may start operation with both Q2 and Q7 conducting. The unlatch circuit operates at power turn-on if the collector of Q2 is low (conducting). The low collector voltage at Q2 cuts off Q1. The rising voltage at Q1 collector charges capacitor C1, which cuts off Q3. With Q3 cut off, Q2 has no source for base current and is also cut off. The rising voltage at Q2 collector makes Q1 conduct, discharges C1, and saturates Q3, which discharges C5. The conduction of Q3 turns on Q2, causing a negative transition voltage to be coupled through C4 to Q7, cutting it off and enabling normal multivibrator action to continue.

(2) *Multivibrator operation*. After initiation of the unlatch sequence, transistor Q2 continues to conduct until capacitor C5 has charged. The conduction of Q2 has cut off Q1 but has not allowed C1 to charge due to the comparatively long time constant of the unlatch circuit components. This keeps Q3 cut off and limits

the base current source of Q2 to C5 only. When C5 has charged, Q2 ceases conduction, causing a rise in Q2 collector voltage and enabling Q7 to start conduction. Diode CR2 provides a current path for discharging C5 which increases the speed that Q2 is cut off and that Q7 is allowed to conduct. The timing capacitor C4 is now allowed to charge and cut off Q7 to continue multivibrator action.

(3) *Frequency control circuit*. Transistor Q6 is a controlled current source that varies the conducting and cut off voltage of Q7. Controlling this parameter determines the length of time that Q7 conducts and, therefore, the period of the multivibrator. The input control voltage is from the phase detector circuit; the greater the phase difference, the greater the input voltage. As the input voltage is increased from 0 volts to approximately 7 volts, the conduction of Q6 is decreased. The decrease in current from Q6 increases the length of time in which charging C4 cuts off Q7. The increase in time-to-charge decreases the frequency. The decreased frequency produces a smaller phase difference which decreases the input control voltage. The frequency range varies from 2400 kHz to 3594 kHz.

b. *Variable Divider* (fig. 2-13 and 2-14). The output of the frequency divider depends on the settings of the frequency select switches. The divider circuit logic produces a different divisor (12, 8, 6, or 2) for four frequency ranges as follows:

FREQUENCY RANGE	DIVISOR
200 to 299.5 kHz	12
300 to 399.5 kHz	8
400 to 535.5 kHz	6
1605 to 1750.5 kHz	2

NOTE

The different divisors are determined by the frequency select switch signals.

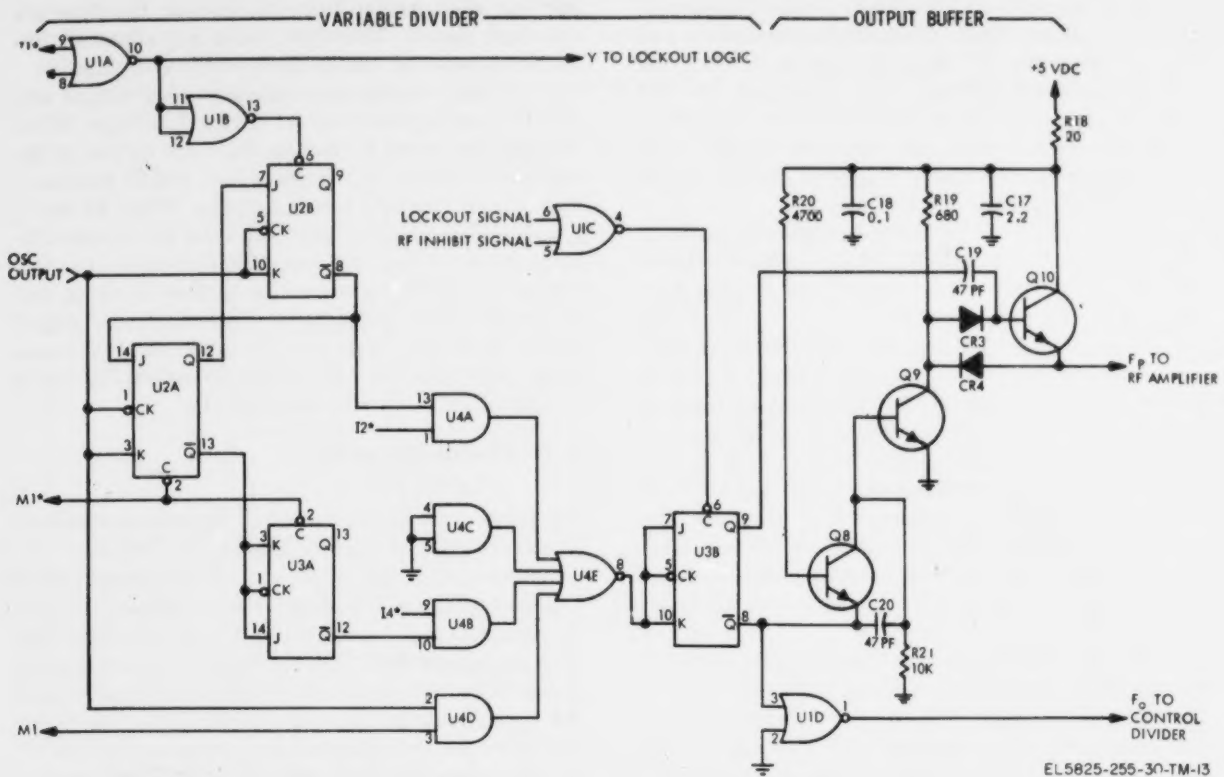


Figure 2-13. Variable Divider Logic and Output Buffer, Functional Schematic Diagram.

(1) In the 200- to 299.5-kHz range, the multivibrator frequency (2400 - 3594 kHz) is divided by 12 as follows: The M1* signal is high enabling flip-flops U2A and U3A to count. Flip-flop U2B is enabled when switch I is not in position 3. With all three count flip-flops enabled, the oscillator output is divided by 6. An additional divide-by-2 flip-flop U3B completes the division.

(2) In the 300 to 399.5 kHz range, the multivibrator frequency (2400 - 3594 kHz) is divided by 8 as follows: When the I switch is in position 3, switch signals I1* and I4 are low, which produces a high output (the Y signal) from U1A. The high is inverted by U1B, producing a low signal which inhibits flip-flop U2B from counting. Operation in this mode produces an oscillator output divided by four signal at gate U4B. Flip-flop U3B provides the additional divide-by-2 to complete the division.

(3) In the 400 to 535.5 kHz range, the multivibrator frequency (2400 - 3213 kHz) is divided by 6 as follows: When the I2* signal is high, it enables gate U4A to pass the divide-by-3 output (fig. 2-14) from U2B to the input of U3B. Flip-flop U3B provides the additional divide-by-2 to complete the division. The output of flip-flop U3A is inhibited by the I4* signal being low when the I switch is in positions 4 and 5.

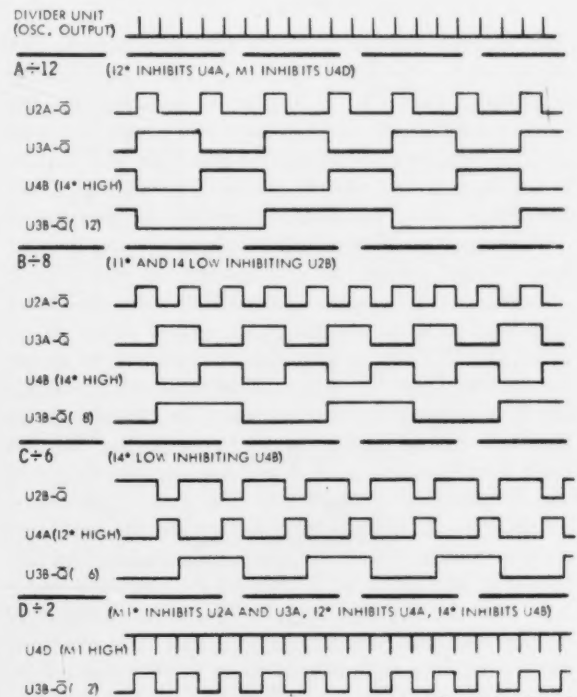


Figure 2-14. Variable Divider Waveforms.

(4) In the 1605 to 1750.5 kHz range, the multivibrator frequency (3210 - 3501 kHz) is divided by 2 as follows: When the M1 signal is high, gates U4A and U4B are inhibited and gate U4D is enabled. The M1 signal is high when the M switch is in the 1 position. With gate U4D enabled, the controlled output of the voltage-controlled oscillator is applied directly to the input of flip-flop U3B for division by 2.

(5) The output of the variable divider is inhibited when a lockout or rf inhibit signal is applied. These high inputs produce a low signal from U1C to hold flip-flop U3B in the cleared state.

c. *Output Buffer.* The output buffer consists of transistors Q8, Q9, and Q10, and the associated biasing and coupling components. The $\bar{Q}$ output of flip-flop U3B controls the switching of transistor Q9 through transistor Q8. Transistor Q10 is an active pull-up load and is controlled by transistor Q9. Capacitors C19 and C20 are speed-up capacitors which decrease the switching response time of transistors Q9 and Q10. Diodes CR3 and CR4 provide drive and load isolation, respectively. The output (Fp) is a symmetrical square wave.

d. *Voltage Regulators.* The three integrated circuit voltage regulators receive +8 vdc, +20 vdc, and -8 vdc and produce regulated +5 vdc, +15 vdc, and -5 vdc, respectively. The regulated +15 vdc and -5 vdc outputs also provide power to the phase detector card.

2-6. Control Divider

(fig. 2-15 and FO-7)

The control divider produces the approximate 500 Hz signal for the phase detector. The control divider consists of a divider, logic gates to recognize the frequency settings of the frequency select switches, a reset flip-flop, and an output flip-flop. The VCO output is the input to the control divider. The settings of the frequency select switches determine the number of VCO output pulses to count before producing the control divider output. If a frequency of 400 kHz is selected, the divider must count 800 input pulses before producing an output pulse. When power is applied, the VCO starts producing pulses and, at an undetermined time, the output flip-flop is set, producing the first output pulse. The output pulse clears the reset flip-flop (the $\bar{Q}$ output is high), removing the low clear level from the reset flip-flop to the last section of the divider (U4 through U8). The reset flip-flop requires a low to be cleared and requires all three J inputs to be high before the clock pulse causes the flip-flop to be set. Since the K input of the reset flip-flop is held low, the flip-flop stays in the reset condition (Q output low) until set by the J inputs. The recognize gates produce a high output when there is one low on each AND gate. The controlling input levels from the frequency select switches are high signals (para 2-3a),

and the reset output from the divider flip-flops are also high signals. Therefore, when any allowable frequency is selected, one or more of the recognize gates has two high inputs which produce a low output and prevent setting the reset or output flip-flops. When the required count is reached, the reset output of the applicable divider flip-flops is low, which enables high output from the recognize gates. When all recognize gates have high outputs, the reset and output flip-flops are set. When the reset flip-flop is set, the last half of the divider is cleared by the low $\bar{Q}$ signal and an output pulse is produced when the input signal clocks the output flip-flop to the reset state at the next input pulse from the VCO. When the output flip-flop is set, gate U14C clears the reset flip-flop.

2-7. Phase Detector

(fig. FO-8)

The phase detector consists of a ramp sample-and-hold phase detector, a voltage follower, a frequency discriminator, an active filter, and an integrated circuit voltage regulator. The phase detector compares a 500-Hz reference signal from the TCXO and fixed dividers with an approximate 500 Hz signal from the control divider. The control divider produces the approximate 500 Hz signal from the output of the VCO. The difference between the reference and approximate 500 Hz signals causes the phase detector to produce a control voltage output to the VCO. The control voltage output changes the VCO frequency output until the reference and approximate 500 Hz signals coincide. The sample-and-hold phase detector produces a ramp synchronized with the reference signal. The ramp voltage is sampled at the frequency of the approximate signal. A changing phase difference causes the sample pulse to occur at a different place on the ramp for each cycle. The varying voltage produced is applied to the voltage follower and then through the active filter to the VCO. The frequency discriminator compares the reference and approximate 500 Hz signals and produces a control signal; indicating the approximate 500 Hz to be higher or lower than the reference 500 Hz. When the frequencies coincide, no control signal is produced and the output of the active filter is a constant level.

a. *Sample-and-Hold Phase Detector* (fig. 2-16). The sample and hold phase detector consists of transistors Q1, Q2, and Q5, and capacitors C2 and C6. The 500-Hz reference signal is differentiated by C1 and R2, and the resulting pulses cause Q1 to conduct and discharge capacitor C2. A ramp signal is formed by charging C2 through resistor R4. The ramp voltage is sampled at the approximate 500 Hz rate by a narrow pulse from Q5, which causes Q2 to conduct and store the charge on C2 at that time on C6.

b. *Voltage Follower.* The voltage follower consists of transistors Q3 and Q4. The high input impedance of

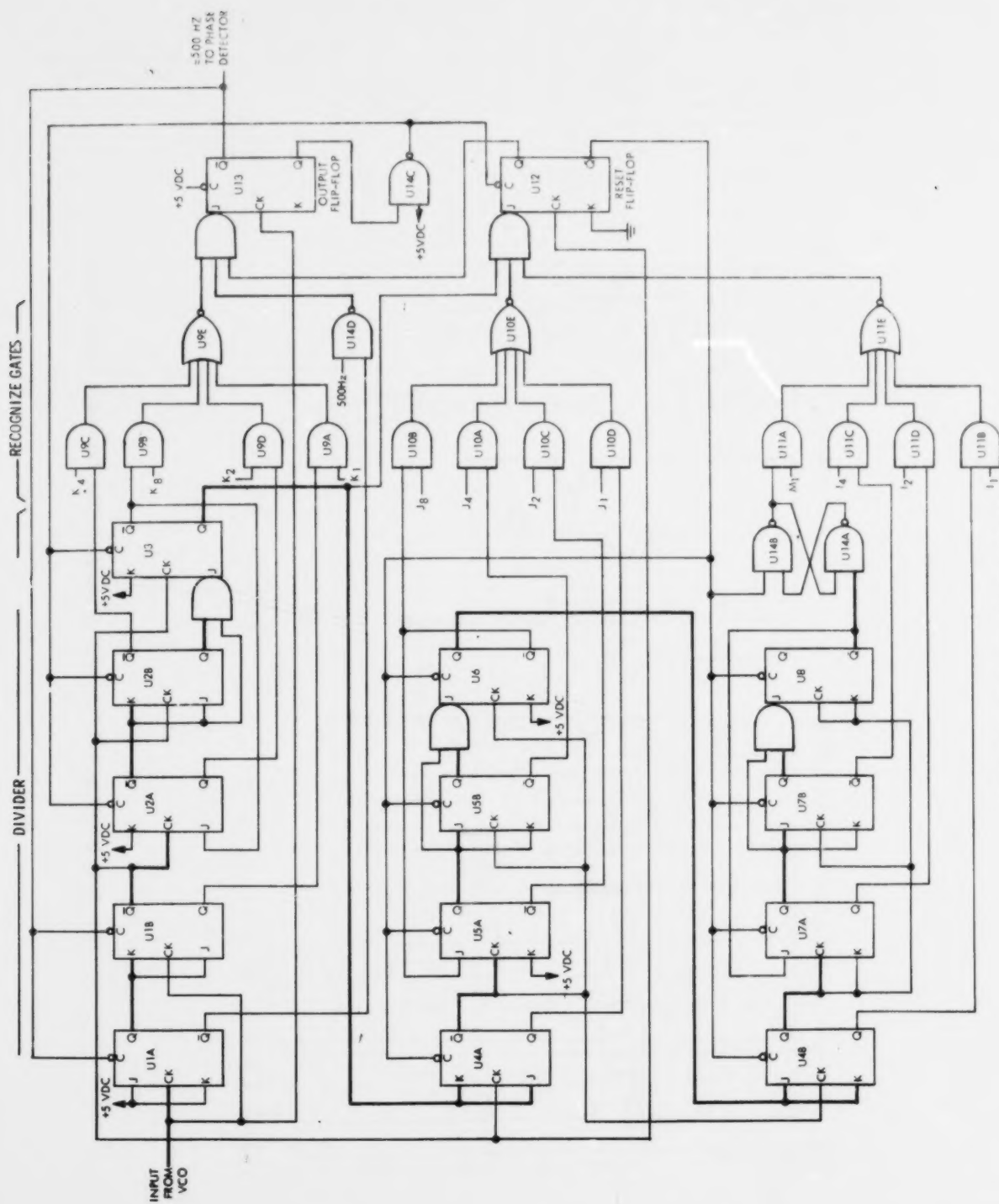
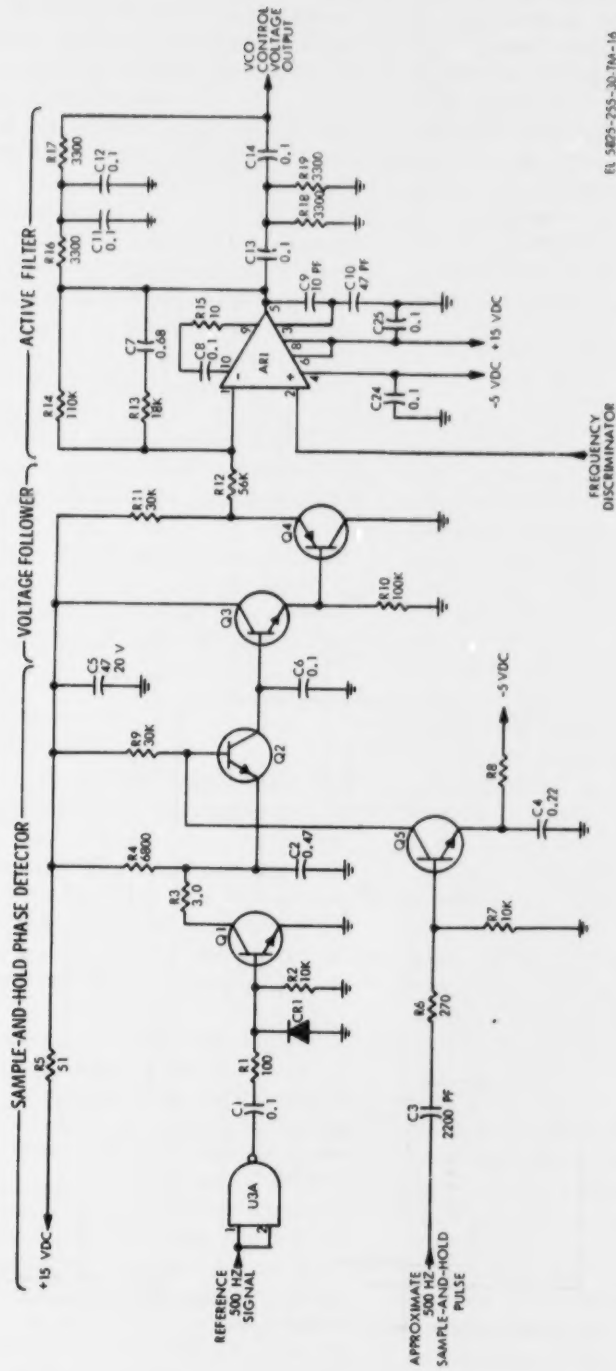


Figure 2-15. Control Divider, Simplified Logic Diagram.



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Figure 2-16. Sample-and-Hold, Voltage Follower, and Active Filter, Functional Schematic Diagram.

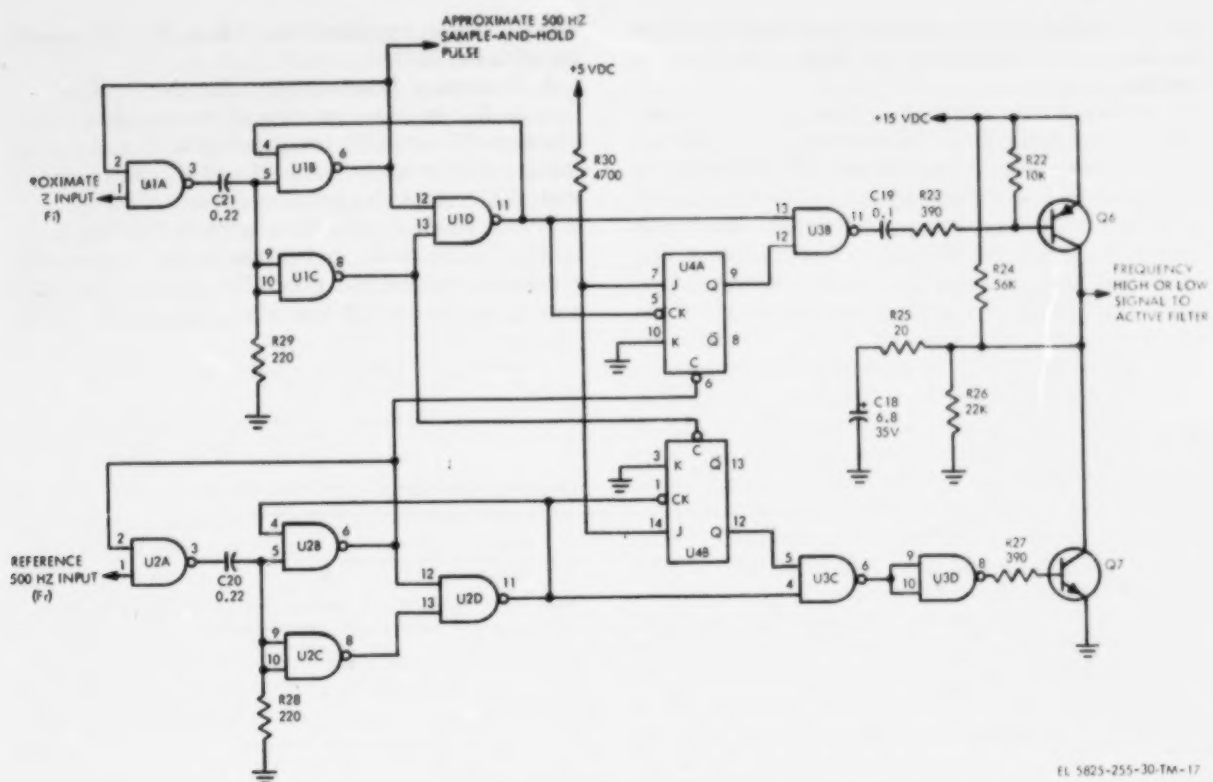


Figure 2-17. Frequency Discriminator, Functional Schematic Diagram.

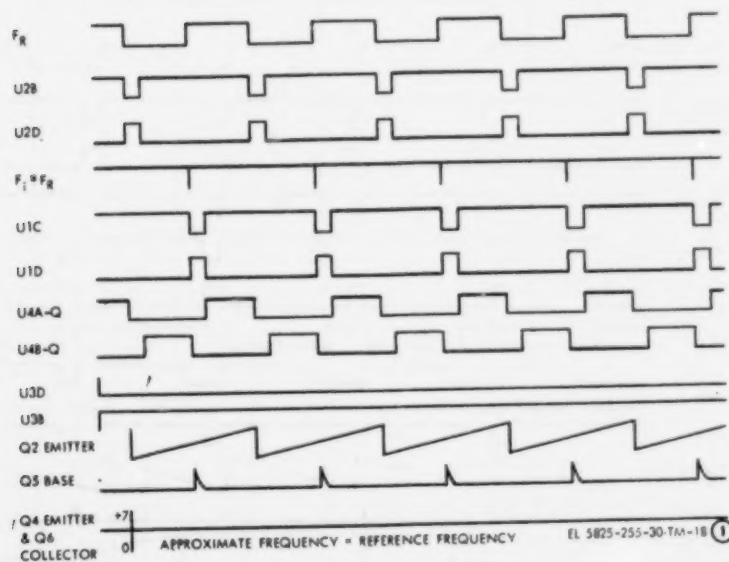


Figure 2-18. Frequency Discriminator, Timing Diagram (sheet 1 of 3).

the voltage follower allows the charge stored by C6 to be held at a constant level until changed by the next voltage sample.

c. *Active Filter.* The active filter consists of differential amplifier AR1. The resistive and capacitive networks determine the overall gain and frequency response of the active filter. AR1 sums the sample-and-hold output from the voltage follower with the output of the frequency discriminator. The frequency discriminator output varies from approximately 0.6 to 8.5 volts. The sum of this voltage and the output of the

voltage follower produces the 0.2 to 7.0-volt control signal to the VCO.

d. *Frequency Discriminator* (fig. 2-17). The frequency discriminator consists of two one-shot multivibrators (U1 and U2), two flip-flops (U4), and a summing amplifier made up of Q6 and Q7. The approximate 500 Hz input is applied to one-shot U1 to produce a 50-microsecond pulse that triggers flip-flop U4, clears flip-flop U4B, and produces the approximate 500 Hz sample-and-hold pulse. The reference 500 Hz is applied to one-shot U2 that also produces a 50-micro-

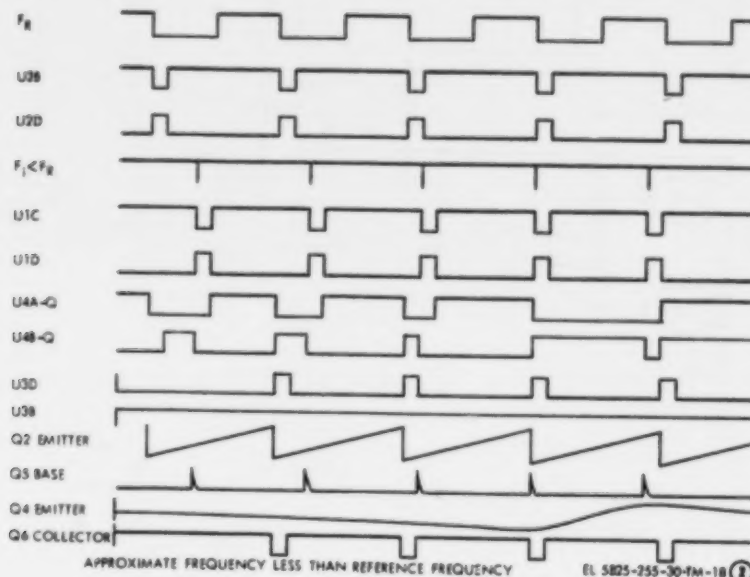


Figure 2-18. Frequency Discriminator, Timing Diagram (sheet 2 of 3).

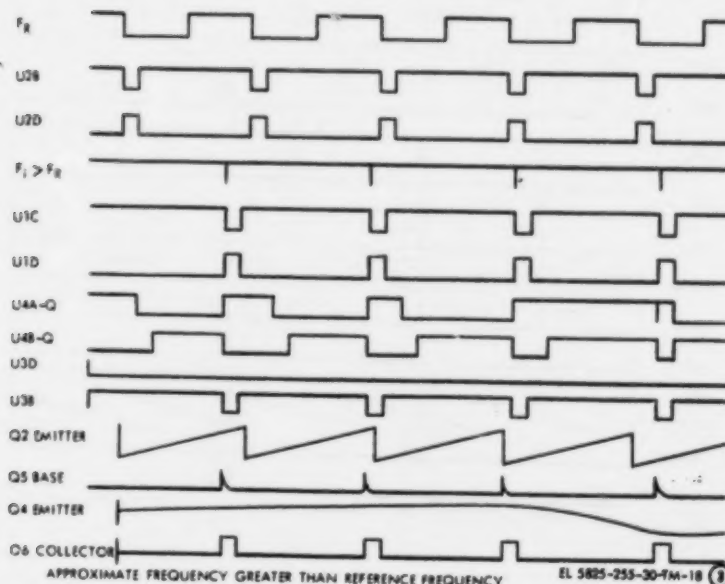


Figure 2-18. Frequency Discriminator, Timing Diagram (sheet 3 of 3).

second pulse. The pulse from U2 triggers flip-flop U4B and clears flip-flop U4A. The timing relationship of signals in the frequency discriminator is shown in figure 2-18. Frequency discriminator operation when the input frequency (F_i) is equal to the reference frequency (F_r) produces a voltage at the junction of Q6 and Q7 equal to the output of the voltage follower (fig. 2-18, sheet 1). When F_i is larger than F_r , the junction of Q6 and Q7 is low (fig. 2-18, sheet 2), and high when F_i is less than F_r (fig. 2-18, sheet 3). The pulses produced at the respective conditions force the output of AR1 to change the frequency of the VCO to achieve coincidence with the reference 500 Hz signal.

2-8. Encoder

(fig. FO-9, FO-10, and FO-11)

The encoder provides Morse code signals according to the settings of the code selection switches. The four switches can be used to select four-letter codes for transmission every 3.5 seconds. The rate at which the code letters are transmitted is determined by the setting of the code rate control. The codes transmitted can be varied from less than 7 words per minute (wpm) to greater than 20 wpm. Four E letters can be transmitted in 2.4 seconds at 7 wpm and 0.8 second at 20 wpm.

a. **CODE Selection Switches.** The CODE selection switches, S8 through S11, produce +5 vdc signals on several of the 13 output lines according to the letters selected. Each switch is sequentially connected to +5 vdc at the common, which have designations L1C through L4C. The output lines are designated as X1 through X13, each of which are isolated from one another by the diodes in the switch assembly. The codes generated for the letters selected are shown in table 2-8. Each X in the table indicates that the respective line will be connected to the common of the switch.

b. **Clock Generator.** The operation of the encoder is controlled by pulses from the clock generator. The clock generator consists of unijunction transistor Q15 and transistor amplifier Q12. The unijunction multivibrator frequency is varied by the CODE RATE control from approximately 6 to 20 cycles per minute. Inverter U8D, U8E, and U8F invert and shape the clock pulses. The clock pulse from U8D is used by the letter counter flip-flops. The clock pulse from U8D is differentiated by rc network R28 and C9, and inverters U8E and U8F shape the narrow differentiated pulse for use by the end-of-letter detector flip-flop U3B and the end-of-word space generator flip-flop U7. The output of transistor Q12 is also sets the bit counter during the operation of the word space generator.

Table 2-8. CODE Selection Switches, Connections

Dial pos.	Letter shown	Common (C) connected to:												
		1	2	3	4	5	6	7	8	9	10	11	12	13
1	A				X									
2	B		X					X						
3	C		X					X	X					
4	D		X					X						
5	E			X		X								
6	F						X	X		X				
7	G		X				X	X		X				
8	H							X						
9	I					X								
10	J				X			X	X			X	X	X
11	K		X					X	X					
12	L				X			X		X				
13	M		X				X	X						
14	N		X											
15	O		X				X	X		X	X			
16	P							X	X					
17	Q		X				X	X	X			X	X	X
18	R				X			X						
19	S													
20	T		X			X								
21	U						X	X						
22	V							X		X	X			
23	W		X					X	X					
24	X		X					X		X	X	X		
25	Y		X					X	X	X		X	X	X
26	X		X					X		X		X		
27	Blank	X				X								

c. **Divide-by-16 and Letter Select Matrix.** The output of the encoder is Morse coded letters selected by the letter selection switches. Each dot and dash is

timed by the clock generator so that each dot is one clock time, each dash is three clock times, and the space between dots and dashes of the same letter is one

clock time. The longest Morse code letters (J, Q, and Y) require 13 clock times. A period of three clock times is inserted between letters. Therefore, a counter having 16 states is required. The divide-by-16 counter is composed of flip-flops U4A, U4B, U5A, and U5B. The counter is set to 1111₂ while waiting for the first letter. When counting is enabled, information from the CODE selection switches on letter selection lines X1 through X13 is sequentially interrogated. The interrogation is performed by the diode matrix which is controlled by the counter. Input lines X1, X3, and X5 to the matrix are inverted by transistors Q1, Q2, and Q3. The CODE selection switch inputs are shown in figure 2-19. Capacitor C3 and the 10K driving resistors, R41 through R53, form a low-pass filter which reduces the transient formed by the switching action of the counter at the output of the diode matrix. The filtered Morse coded output drives Q9.

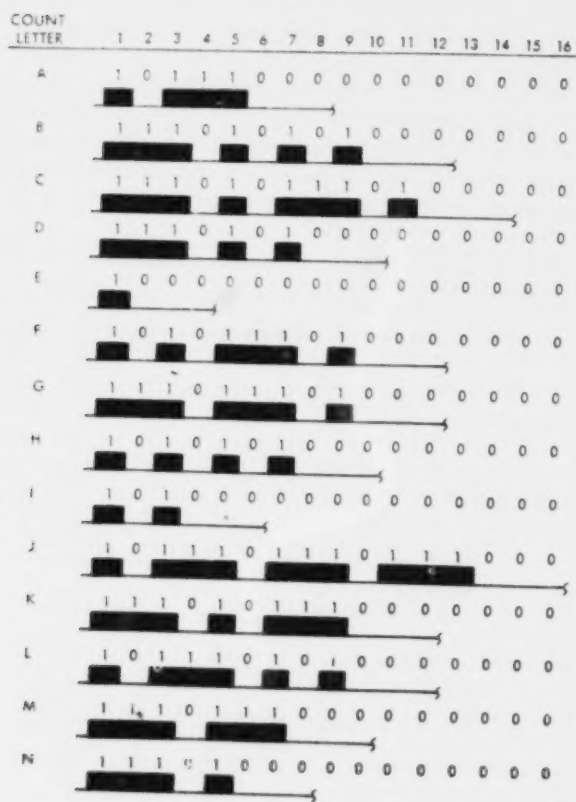
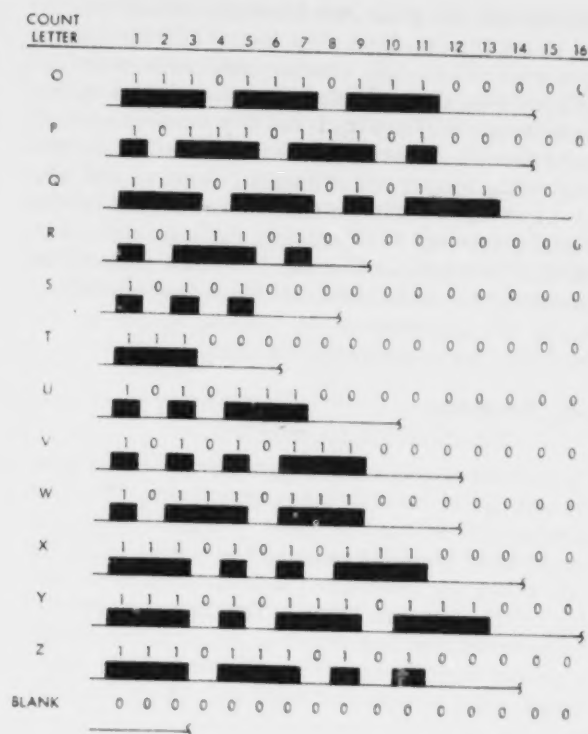


Figure 2-19. Bit Time and Code Waveforms (sheet 1 of 2).

d. **End-of-Letter Detector.** The end-of-letter detector generates the space between letters. As shown in figure 2-19, the three spaces at the end of each letter code signify the end of the letter. Therefore, to detect the end of a letter, the three-bit counter counts three clock pulses when there is no code output and then, at



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Figure 2-19. Bit Time and Code Waveforms (sheet 2 of 2).

the next clock pulse, generates a reset signal to reset the bit counter. The end-of-letter detector consists of U2A, U3A, U2B, U3B, U2C, and U2D. The clock pulse and the output signal set flip-flop U3A. If there is another code bit output signal with the next clock pulse, the bit counter is reset. If not, the bit counter continues to count until count three is reached. When the bit counter reaches a count of four, gate U2D produces a high signal to advance the letter selection counter. Driver U8A then produces a low signal to preset the bit counter to 1111₂.

e. **Letter Select Counter.** The letter selection counter enables the +5 vdc to the letter selection switches. In count states 00₂ through 11₂, signal lines L1C through L4C are individually enabled. The counter counts continuously without being reset, and as the counting progresses, decoding diodes of Z3 turn on transistors Q4, Q5, Q6, and Q7, which enable high signals for lines L1C, L2C, L3C, and L4C, respectively.

f. **End-of-Word Space Generator.** The end-of-word space generator is a 3.5-second one-shot multivibrator consisting of Q11, Q13, Q14, and flip-flop U7. The output space pulse is generated when L1C is high. The initial pulse turns on transistor Q11, which grounds and turns Q14 off. The output of flip-flop U7 is set high at the next clock pulse, then with the high from

L1C, they enable NAND gate U1D, which produces a low signal that holds the end-of-letter detector cleared, inhibits the code modulated output from transistor Q10, and generates a low signal from U8A to set the bit counter to 1111. At the end of 3.5 seconds, capacitor C8 has charged (through the constant-current source circuit of Q13) to a value that turns on transistor Q14 and produces a low output from flip-flop U7 and enables the code output, the bit counter, and the end-of-letter detector.

g. Sample Operation. The operating sequence of the transmitter starts with the MODE switch in the CW position. The letter code is selected with the CODE switches, and the MODE switch is set to the MCW position. The code information from the CODE selection switches for the first letter is applied to the diode matrix and is sampled by the bit counter. For example, if the first letter is A, a dot (one bit time), a space (one bit time), a dash (three bit times), and a three-bit time space will result. After the three-bit time space, the end-of-letter detector advances the letter selection counter to letter two and presets the bit counter to 1111. The sequence continues until the three-bit space at the end of the fourth letter ends. Then the end-of-word space generator starts. After 3.5 seconds, the entire sequence repeats. The OR gate consisting of CR14, CR15, and CR16 combines the 1020-Hz identification tone with the automatically coded signals from Q9 and the end-of-letter inhibit.

h. Voltage Regulator. Hybrid VR1 and associated components constitute a +5 vdc voltage regulator. Transistor Q8 and inductor L1 form an overcurrent

protection circuit. In this circuit, L1 is used as a 2.2-ohm resistor and not as an inductor. The +5 vdc output provides a regulated voltage for the circuits in both encoder cards.

2-9. Rf Power Amplifier

(fig. 2-20 and FO-12)

The rf power amplifier provides a modulated 28-watt signal that is applied through the antenna coupler to either the 30-foot antenna or to the 15-foot antenna. The output of the rf amplifier also drives the amplifier in either the tactical or semiautomatic modes of operation. The rf amplifier contains an RF driver stage and a class S push-pull rf final stage.

a. Rf Driver. The rf driver consists of an inverter and push-pull switching amplifier. The low level square wave signal from the frequency synthesizer is inverted by transistor Q1. The outputs of Q1 are balanced waveforms which drive the push-pull amplifier consisting of transistors Q2 and Q3. The collector voltage of Q1 is coupled through capacitor C2 and resistor R4 to the base of Q2. The emitter voltage of Q1 is coupled through capacitor C3 and resistor R3 to the base of Q3. The maximum base current on Q2 and Q3 is limited by resistors R3 and R4. Speed-up capacitors C2 and C3 increase the switching speed of transistors Q1 and Q2. Because Q2 and Q3 collectors are dc coupled to the power supply, all transistors must be shut off when no signal is applied to transistor Q1. Therefore, dc blocking capacitor C1 inhibits driving Q2 when no signal is applied to Q1. Resistor R5 provides a discharge path for the base storage charge of

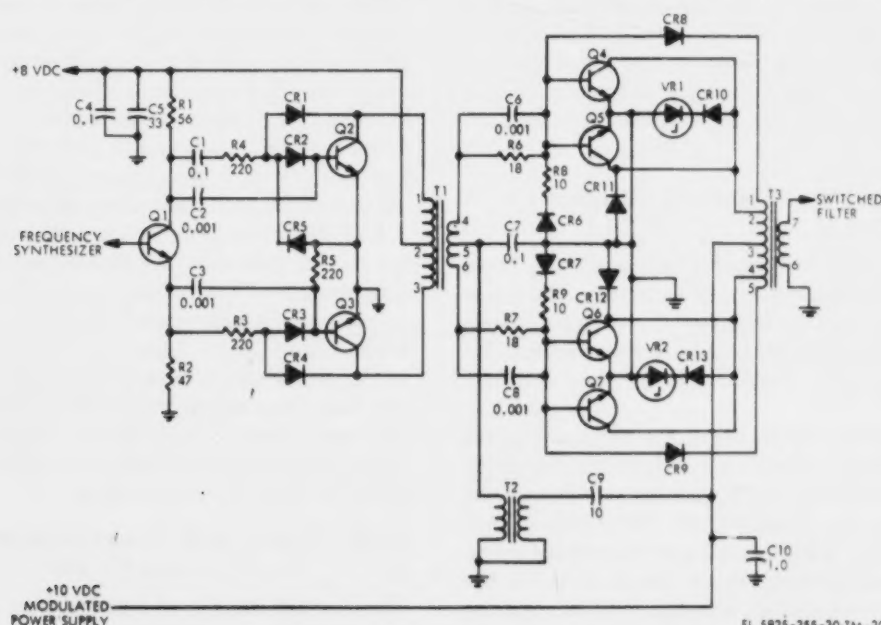


Figure 2-20. Rf Power Amplifier, Functional Schematic Diagram.

Q3. Saturation of Q2 and Q3 is prevented by the clamp circuits consisting of diodes CR1, CR2, CR3, and CR4. The diodes maintain a stabilized emitter-collector voltage by shunting base current into the collector when the collector voltage starts to drop below the base voltage. This stabilization and reduction of the base stored charge prevents saturation of the transistors. The output signal is coupled through transformer T1 to the rf amplifier.

b. *Rf Amplifier.* The input signal from the rf driver is applied to a Class S push-pull amplifier consisting of transistors Q4, Q5, Q6, and Q7. The signal is coupled through capacitor C6 and resistor R6 to the bases of Q4 and Q5, and through capacitor C8 and resistor R7 to the bases of Q6 and Q7. The maximum base currents are limited by R6 and R7. Speed-up capacitors C6 and C8 increase the switching speed of transistors Q4 through Q7. The diode-resistor combinations of R8 and CR6 and R9 and CR7 limit the reverse base emitter voltages of Q4, Q5, Q6 and Q7, and provide a balanced load for the transformer, which prevents the signals from flowing through the center tap of T1. The zener diodes VR1 and VR2 are clamps which limit switching transients on the collectors to a maximum of 60 volts. Diodes CR8 and CR9, along with taps on transformer T3, form a feedback circuit which prevents the output transistors from saturating. When the collector voltage starts to drop below the base voltage, the feedback loop shunts the base current, preventing the collector-base junctions from becoming forward biased. Additional base drive is required for the modulation peaks to keep the collector-emitter voltage at the proper value. The additional drive is provided by applying a percentage of the modulation signal to the bases of the transistors through capacitor C9 and transformer T2. The output of the amplifier is coupled through T3 to the switched filter in the antenna coupler.

2-10. Transmitter Antenna Coupler (fig. 2-21)

The transmitter antenna coupler automatically tunes the 15-foot or 30-foot antenna to resonance. The transmitter antenna coupler consists of a switched filter, power and phase detector, logic servo, variable inductor (variometer), tapped inductor, and a servo-motor drive.

a. The functional operation of the antenna coupler is started by the selection of a transmitting frequency with the FREQUENCY KHZ selection switches on the front panel of the transmitter. The lockout logic initiates the filter select signal that drives the servo-motor until the filter select signal that is applied to the filter select switches S1A through S1E is removed from the motor drive logic circuit. The circuit performs an open-seeking function. When an open is de-

tected, the motor drive assembly has driven the filter select switches (S1 and S2) to the proper bandpass filter for the frequency selected.

b. The rf signal (sine wave) is then applied to the detector assembly, which senses its relative power level and its current-voltage phase relationship. The detector generates the logic signals which drive the motor servoamplifier during tuning. After the correct filter is selected, the correct inductance on the tapped inductor is selected. The fine tuning is accomplished by the variometer during the final tuning of an antenna coupler, produces maximum power when the current and voltage of the antenna circuit are in phase, and stops the motor.

c. When the transmitter is connected to the amplifier, relay K1 is energized which bypasses the rf input around the antenna coupler to the rf connector.

2-11. Transmitter Switched Filter (fig. FO-13)

The switched filter selects the proper bandpass filter and matches the output of the rf amplifier. The assembly consists of five bandpass filters and two switches, which are driven by the incremental 12:1 motor-gear drive assembly (fig. 2-21).

a. *Bandpass Filters.* Each filter consists of a series and parallel inductance and capacitance network. The output of each filter is tapped to provide an impedance match between the rf amplifier and the resonant antenna. When the 15-foot antenna is in use, relay K2 is energized to select the second output on the fifth filter and match the impedance of the antenna. Relay K3 disconnects the tapped inductor to reduce the effects of stray capacitance. In the tactical or semifixed mode of operation, relay K1 is energized by connecting the audio cable between the amplifier and the transmitter thereby transferring the RF signal from the switched filter to the RF connector on the front panel. This low level RF signal is also applied to the power detector portion of the power and phase detector circuitry.

b. *Filter Selection.* Switches S1 and S2 are driven by the incremental 12:1 motor-gear drive assembly. The input from the lockout logic provides a high signal to switches S1A through S1E, which causes the filter force signal to go high and start the motor. The switches start to revolve until an open is indicated at the filter force signal input, which stops the motor. At the same time, S1 and S2 are turned and when the motor stops, the switch taps are connecting the proper filter for the frequency selected.

2-12. Power and Phase Detector (fig. FO-14 and FO-15)

The detector consists of a power detector circuit and a phase detector circuit. The power and phase detector determines the power level of the rf signal and the

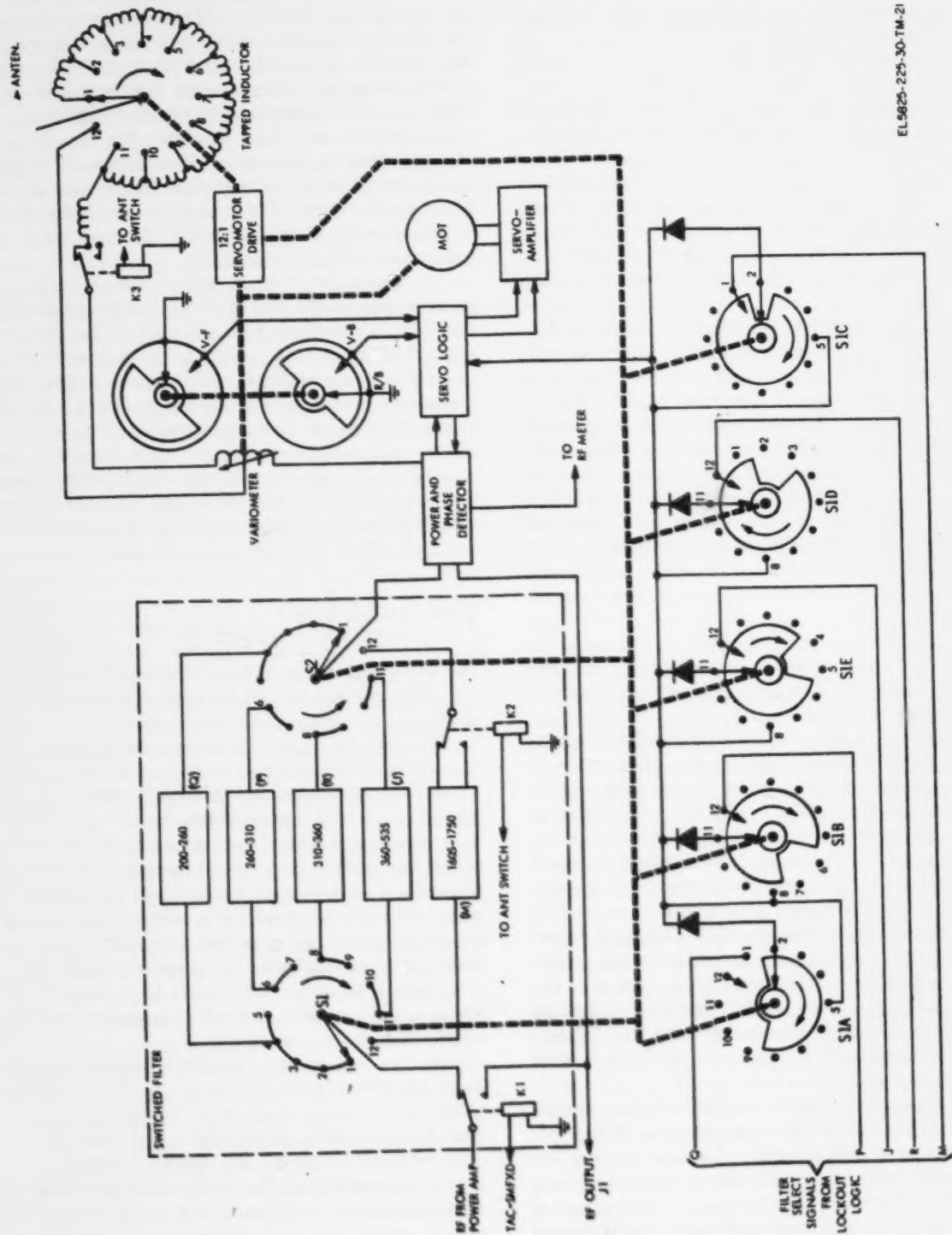


Figure 2-21. Transmitter Antenna Coupler, Functional Diagram.

phase relationship of the rf current and voltage. In the tactical or semifixed mode of operation, the phase detector is inoperative and only the power detector transformer is operative.

a. *Power Detector.* In the pathfinder mode of operation, the rf signal is sampled by transformer T1 and rectified by diode CR2. The dc voltage is applied to operational amplifier AR1 and compared with a fixed voltage of 0.26 volt. The output of AR1 is low when the rf current is less than 100 milliamperes, indicating low power is generated. The output of AR1 is high when the rf signal current is greater than 100 milliamperes and the logic signal is high, providing an indication of high power. The rectified voltage from CR2 is also applied to the input of operational amplifier AR2. The input circuit to AR2 is such that the dc voltage applied to AR2 must be equivalent to a rf current level of greater than 230 milliamperes to produce a low output from AR2. Therefore, at rf currents between 100 and 230 milliamperes, the outputs of AR1 and AR2 are both high. The rectified voltage is also applied to the RF meter on the front panel. The voltage from CR2 is limited by diode CR3 and applied to the meter after filtering by capacitor C3. The low level rf input is open in the pathfinder mode. In the tactical or semifixed mode of operation, the meter is driven by the low level rf, which is also the excitation voltage for the amplifier.

b. *Phase Detector.* The phase detector compares the phase of the rf voltage and current. When an in-phase condition is sensed, the antenna circuit is resonant at the frequency being transmitted.

(1) The rf voltage is sampled by direct connection to the rf line at T2. The current is sampled by current transformer T2. The voltage and current RF signals are sine waves which are clipped and limited at the inputs to operational amplifiers AR3 and AR4 by diodes CR4 through CR7. The outputs of amplifiers AR3 and AR4 are square waves in sync with the input signals. The square wave signals are divided by two by flip-flops U1A and U1B. This provides additional squaring, and ensures a 50 percent duty cycle of the output signals to U4A and U4B. Gate U2B ensures that the input signals applied are not 180 degrees out-of-phase and gate U2A output RC network (R28, C11) determines the smallest difference to be recognized as an out-of-phase condition.

(2) When the rf voltage sample leads the current sample, the antenna circuit is too inductive. Therefore, the variometer turns in the direction of less inductance. Direction A, the ΦA output, is then high and drives the motor. When the antenna circuit presents a capacitive load, the square wave input to AR3, current, leads the voltage input and the ΦB output is high. The ΦA and ΦB output signal reset circuit consisting of flip-flops U3A and U3B, clears the output flip-flops

(U5A, U5B) at the servo logic clock frequency (approximately 200 Hz) thereby making both the output signals low. Flip-flop U3B is clocked set by servo clock and cleared by Q1 and the associated RC network. The $\bar{Q}$ signal from U3B presents flip-flop U3A to clear the output signal flip-flops U5A and U5B. At the next period of the input rf signal, v both inputs to gate U2A are high, flip-flop U3A cleared, which removes the clear level from the output flip-flops and allows the next pulse in to set the output flip-flops. The output flip-flops are set according to the condition of flip-flops U4A and U4B, which store the input phase difference condition.

(3) When the input rf voltage sample leads the current sample, flip-flop U1B is clocked before flip-flop U1A. When flip-flop U1A is clocked, the high output of U1B clocks U4A. Since U4B was not set, flip-flop U5A is set and flip-flop U5B remains reset. This produces a high ΦA motor drive signal and a low ΦB motor drive signal. This configuration of motor drive signals causes the motor to drive the variometer toward lower inductance, direction A, to regain an in-phase condition. The inverse occurs when the current sample leads the voltage sample to generate low ΦA and high ΦB motor drive signals to the motor servo logic.

2-13. Servo Logic

(fig. FO-16 and FO-17)

The servo logic provides logic information to control the speed and direction of the servomotor, inverts the $\bar{M}$ signal, and supplies power to the detector.

a. *Servomotor Logic.* The servomotor logic controls the fast and slow cw and slow ccw rotation of the motor and generates the rf on/off command and modulation inhibit signals. When the M^* input is low, the output signal is high, indicating that the frequency selected is greater than 1000 kHz and that the high range filter should be selected. When the tactical or semifixed mode of operation is selected, the tactical, semifixed signal input is low (grounded when the audio cable is connected). This produces a high output from gate U3C and a low output from inverter U6, which is the low level rf on/off command signal that enables the synthesizer circuits.

(1) The low tactical, semifixed signal also produces a high level at the output of gate U3A, which inhibits any cw motor rotation. In the tactical or semifixed mode, the RF is not applied to the phase detector primary input circuit and the detector produces a level low power signal. The zero level low power signal clears flip-flop U5A to produce a low $\bar{Q}$ output. The low $\bar{Q}$ output from U5A clears flip-flop U4 and produces a high output from U7B. This high signal enables transistor Q5 to conduct and cut off transistor Q7, which produces the high level modulation inhibit

signal.

(2) The variometer output signals, the filter force signal, and the power signals all have an effect on the modulation inhibit and RF on/off command signals. When the variometer front-back signal is low or the filter force signal is high, the antenna coupler is in the coarse tuning mode and rf is inhibited. When the filter force signal is high, a high signal from U3B enables gates U3C and U6, which produce the high level rf on/off signal to inhibit the output of the VCO. When the correct filter has been selected, the filter force signal is low and if the variometer is now on the front side where cw rotation produces decreased inductance, the variometer front-back signal and the variometer force signal are high. At this time, the high rf on/off command signal is removed and rf is enabled.

(3) Enabling the rf allows some rf current to flow through the antenna circuit. If the antenna current is less than 100 milliamperes, the zero level low power signal clears flip-flop U5A, which clears flip-flop U4 and produces a high signal output from gate U7B. Transistors Q5 and Q7 then produce the one level modulation inhibit signal that prevents modulation. When tuning is complete enough to allow more than 100 milliamperes of antenna current, the low power signal goes to a one level, which produces the zero level modulation inhibit (enables modulation) signal to be produced at the next clock pulse to flip-flop U5A. The modulation inhibit signal, in addition to enabling modulation, enables the +10 vdc power supply to change from its quiescent output of approximately +4 vdc to +10 vdc.

(4) The increase in power supply voltage produces antenna currents over 230 milliamperes. At this time, the one level high power signal goes to a zero level, which clears flip-flop U5B. After this point, if the antenna current drops below 230 milliamperes, the high power signal goes to a one level, flip-flop U5B is set by the next clock pulse and produces a one level Q output. This output clocks flip-flop U4 to produce a low $\bar{Q}$ signal, which inhibits the RF modulation as did the one level low power signal. The total tuning cycle is now started again to raise the antenna current over the 230-milliamper point to enable modulation. After the 100-milliamper antenna current is exceeded, the cw and ccw motor drive control signals control the motor. Initially, the motor was driven at full speed cw until the variometer force signal became high. From that time, the motor was driven at medium speed by the drive signal applied to gate U1A.

(5) The servo logic produces high cw and ccw motor drive signals which control motor rotation. The output of U7B, when the low power control is high, overrides the drive input to U1A and allows the drive signal output of gate U1B to control the slow cw motor rotation. At this time, the clock is also applied

to gate U1C to control slow ccw motor rotation. The outputs of gates U1B and U1C are high to inhibit motor rotation. When a high level $\bar{Q}$ A or $\bar{Q}$ B signal from the detector is applied, the resulting high signal from U7D or U6D enables the drive signal input to U1B or U1C to drive the motor in the cw or ccw direction. Normal $\bar{Q}$ A and $\bar{Q}$ B signals for tuned conditions are zero level, inhibiting motor drive in either direction.

b. *Clock Generator.* The clock generator consists of a unijunction multivibrator, an amplifier, and a logic inverter. The narrow spikes of the multivibrator are applied to transistor Q10. The output of Q10, a high level with negative-going pulses, is inverted by U7C, which provides a clock pulse to the detector and servo logic amplifier.

c. *Drive Motor Tachometer and Constant Speed Amplifier.* The drive motor tachometer consists of operational amplifiers U8, U9, and U10. Amplifiers U8 and U9 are driven by the motor back emf and motor drive signals from the motor servoamplifiers. These two amplifiers sense motor speed in both directions. The signal produced by these amplifiers is the same polarity regardless of motor direction and is a duplicate of the motor drive signal pulses with the value of back emf, which varies with motor speed, in between the pulses. Transistors Q11, Q4, and Q9 prevent the motor drive pulses from being applied to the operational amplifier U10 inverting input. Each motor drive pulse generated by constant speed amplifier AR1 turns off Q9, which enables Q4 to conduct and cut off Q11 during the motor drive pulse time. Therefore, the signal applied to operational amplifier U10 is only the varying dc level generated by the motor back emf, which is proportional to motor speed. During maximum speed conditions (filter switching), the motor speed control circuit has no effect on motor speed.

(1) The motor speed is changed to medium speed when the correct filter is selected. The motor drive signal is applied through U1B to gate U2A to control the speed of the motor. The difference between the +3 vdc level at the noninverting input of U10 and the dc level produced by operational amplifiers U8 and U9 at the inverting input, causes an increase or decrease in the output of U10, which changes the duty cycle of pulse generator AR1. The changed duty cycle increases or decreases the motor speed to achieve a motor speed resulting in a balanced input to U10. The duty cycle is varied to achieve a motor speed which is independent of the load on the motor. If at one point, the load on the motor increases and the motor attempts to slow down, amplifier AR1 increases the duty cycle of the drive signal to produce more power and force the motor to overcome the increased load and maintain the constant speed. When the lower power signal is high, signifying antenna current is greater than 100 milliamperes, transistor Q8 conducts, changing the dc

input to U10 to approximately +1.3 vdc. This lower reference voltage causes the motor to move at creep speed until a tuned condition exists.

(2) During creep speed operation, the motor speed voltage input and reference voltage input to U10 cause the variable duty cycle adjustment to maintain constant motor speed. At the time the turned condition is achieved, both QA and QB signals are low, producing a high output from gates U6A and U6C. These two high inputs, with the high input from Q5, cause U2B to be high, which enables Q3 to conduct and place an input of approximately -0.5 vdc on the input to U10. This produces an output from U10 of approximately -0.7 vdc, which inhibits any output from the constant speed amplifier and prevents transient pulsing of the motor that may drive the motor away from the in-tune position.

d. **Voltage Regulators.** Voltage regulators VR1 through VR3 provide the function voltages for the servo logic circuits and also are applied to the detector. The +24 vdc input is applied to VR1, which generates +12 vdc. The ± 8 vdc power supply provides the inputs to VR2 and VR3, which generate -5 vdc and +5 vdc, respectively.

2-14. Transmitter Servomotor Drive (fig. FO-18)

The servomotor drive provides the mechanical functions required to operate the filter switch selection, variometer, and the tapped inductor (fig. 2-21). The

assembly consists of a servoamplifier and a motor drive.

a. **Servoamplifier** (fig. 2-22 and FO-19). The servo amplifier applies +24 vdc to the drive motor, as commanded by the cw and ccw logic signals from the servo logic. The ccw and cw signals cause the motor to run when the respective signal is low. When the cw signal is low, transistor Q1 is cut off, presenting a high voltage to the base of transistor Q3 and turn on Q3. Transistors Q6 and Q7 are turned on and drive the servomotor cw. When the ccw signal is low, a similar action occurs, enabling transistors Q4, Q5, and Q8 to drive the servomotor ccw.

b. **Motor Drive.** The motor drive consists of a dc motor driven in the cw and ccw directions, the gear assembly on the motor, and an intermittent drive mechanism to drive the switched filter select switches, the tapped inductor select switch, and the filter select signal open seeking switches. These switches are driven on position (30 degrees) for each revolution of the motor by the 12:1 intermittent drive.

2-15. Tapped Inductor

The tapped inductor (fig. 2-21) consists of 12 inductors wound on a common form. The taps of the inductor are selected by a high voltage switch driven by the 12:1 motor gear drive assembly.

2-16. Variometer (fig. FO-20)

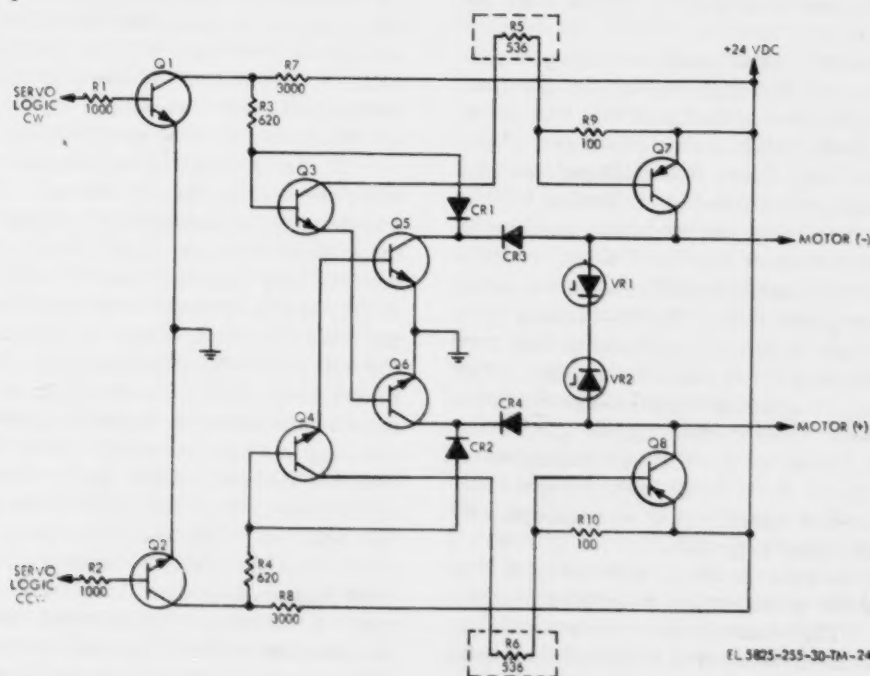


Figure 2-22. Servoamplifier, Functional Schematic Diagram.

vdc that prevents Q6 from turning on from spurious signals on the output of AR3. Resistor R27 provides the quick turn-off time for 1Q2. Amplifier AR3 is protected from high differential input voltage spikes by diodes CR11 and CR12. Capacitors C31 and C32 provide frequency stabilization for AR3.

e. When 1Q2 stops conducting, the voltage across the primary of T2 reverses polarity and the current is discharged through diode CR8 and the output load. As the inductor current decreases, the difference current is supplied by C36, C37, and C38 and the sampling voltage starts to drop. When the reference voltage exceeds the sampling voltage, the cycle starts over. The cycle repeats at a rate that is determined by the input voltage and the output load. The +8 vdc output is filtered by inductor L3 and capacitor C40, which reduces the ripple generated by the switching regulator.

f. Due to the fluctuating current in the primary of

T2, an alternating voltage is induced into the secondary. This voltage is rectified by diode CR10 charges capacitor C33 to a negative voltage. The age is regulated by hybrid voltage regulator V_{NO}, providing a -8 vdc output. Capacitor C39 filters the output ripple due to the switching action. Resistor R31 protects the regulator from current surges and (a stabilizer capacitor.

2-19. +10 Vdc Modulated Power Supply (fig. 2-24)

a. The modulated +10 vdc power supply provides +10 vdc to the rf amplifier during cw transmission. When a 1020 Hz signal is received from the encoder, the +10 vdc is driven sinusoidally from approximately +0.5 to +19.5 volts. During the tuning cycles, the output of the +10 vdc supply is approximately +4 vdc and modulation is inhibited.

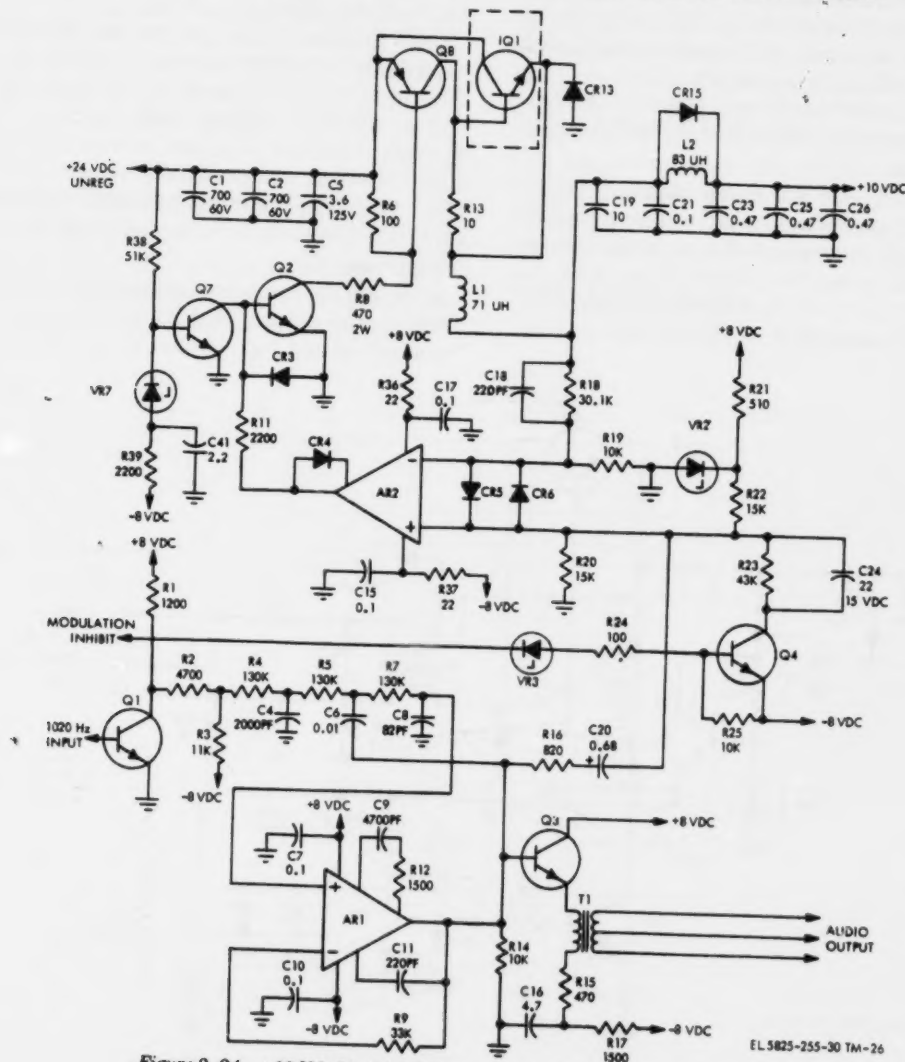


Figure 2-24. +10 Vdc Modulated Power Supply, Functional Schematic Diagram.

b. The input voltage is filtered by capacitors C1, C2, and C5 and is processed by a switching network similar to the one in the ± 8 vdc power supply to provide a regulated +10 vdc. The 1020-Hz square wave signal from the encoder is converted to a sine wave and fed through the reference voltage divider to modulate the output voltage.

c. The 1020-Hz square wave modulation signal is applied to the base of transistor Q1. When the input signal is high, a negative potential is placed at the junction of resistors R2 and R3. When the input signal is low, Q1 is effectively an open circuit and a positive potential is placed at the junction of R2 and R3. The ratio of resistors R1, R2, and R3 produces a symmetric square wave, varying from +2.5 volts to -2.5 volts, that is applied to a low pass filter consisting of resistors R4, R5, and R7, capacitors C4, C6, and C8, and amplifier AR1. The filter has a cutoff frequency of slightly more than 1050 Hz, which passes only the fundamental 1020 Hz sine wave. The sine wave output of the filter is applied through R16 and C20 to reference voltage divider R20, R22, and VR2, and then to comparator AR2.

d. The 1020-Hz sine wave is applied to common-collector amplifier Q3, which has the primary of transformer T1 in its emitter circuit. Resistor R15 aids in matching the primary of T1 to the secondary load. The output of T1 has a balanced center tap and provides 1 milliwatt of the 1020-Hz identification tone to a 600-ohm load through the AUDIO OUTPUT connector.

e. Control of switching power transistor 1Q1 is provided by AR2, Q2, and Q8. The reference voltage of AR2 is derived from zener diode VR2 and divider resistors R20 and R22. During modulation, the 1020 Hz sine wave adds to or subtracts from the reference voltage at the noninverting input of AR2. The sampling voltage from the output of inductor L1 is applied to the inverting input of AR2. This sampling voltage is applied through a voltage divider network consisting of resistors R18 and R19. Overload protection for AR2 is provided by diodes CR5 and CR6. Stability is ensured by diode CR4 and a decoupling circuit consisting of capacitors C15 and C17 and resistors R36 and R37.

f. At initial turn-on, the reference voltage is higher than the sample voltage. The output of AR2 becomes positive and turns on transistor Q2. The current flowing through the base-emitter of Q8 turns it on along with 1Q1. The output of 1Q1 charges capacitor C19 through L1. As the voltage across C19 increases, a sample is applied to the inverting input of AR2. When the sample voltage exceeds the reference voltage, AR2 is driven negative and turns off Q2. This interrupts the base-emitter current through Q8 and turns off 1Q1.

g. While 1Q1 was conducting, the increasing current produces a voltage drop across L1 with a negative potential on its output. With 1Q1 turned off, the

potential across L1 is reversed and diode CR13 conducts, thereby discharging the current through CR13, L1, and the output load.

h. When the current supplied by L1 falls below the load current, C19 supplies the difference to the output load. The sample voltage to AR2 then falls below the level of the reference voltage and Q2, Q8, and 1Q1 are turned on again. The cycle repeats at a rate determined by the input voltage and the output load. The output voltage is filtered by a low pass filter consisting of inductor L2 and capacitors C21, C23, C25, and C26. The output filter passes the 1020 Hz sine wave and attenuates the switching frequencies of the regulator.

i. When the modulation is inhibited and the output voltage is reduced, a high level command voltage is received from the servo logic assembly. This voltage turns on Zener diode VR3, driving transistor Q4 to saturation, which applies a -8 vdc through R23 to the noninverting input of AR2. The reference voltage then drops, decreasing the output voltage to approximately +4.0 vdc. The 1020 Hz sine wave is effectively ac grounded through capacitor C24.

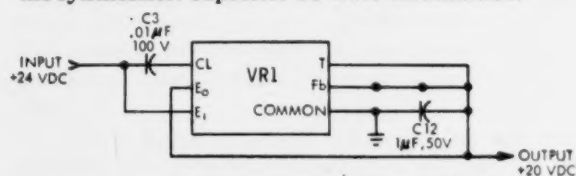
j. To eliminate transients caused by the +10 vdc supply turning on before the -8 vdc supply, the output of AR2 is inhibited until the -8 vdc supply reaches full potential. When the unregulated supply is first turned on, current through resistor R38 turns on transistor Q7, which turns off Q2. As the -8 vdc supply reaches full potential, capacitor C41 starts to charge through resistor R39. When the charge across C42 reaches the firing voltage of Zener diode VR7, Q7 cuts off and Q2 conducts.

k. As the sample voltage applied to AR2 exceeds the reference voltage, the output of AR2 goes negative and turns Q2 off. Diode CR3 then conducts and limits Q2's negative base emitter voltage. When Q2 turns off, 1Q1 also turns off. Resistors R6 and R13 discharge the current from the base-emitter junctions of Q8 and 1Q1. When the -8 vdc supply reaches its potential, zener diode VR7 conducts, which turns Q7 off and allows AR2 to control Q2.

2-20. +20 Vdc Power Supply

(fig. 2-25)

The input voltage from the battery or an external source is applied directly to hybrid voltage regulator VR1. The regulated +20 vdc output from VR1 is filtered by capacitor C12 and applied to the TXCO in the synthesizer. Capacitor C3 is for stabilization.



EL 5823-255-30-TM-27

Figure 2-25. +20 Vdc Power Supply. Schematic Diagram.

Section II. AMPLIFIER

2-21. General

(fig. 2-26 and FO-22)

The amplifier connected to the transmitter constitutes Beacon Set, Radio AN/TRN-30(V)2. In the tactical or semifixed modes of operation, the transmitter is used as a driver for the amplifier. The power output is 60 or 180 watts, depending on operating mode. The frequency range is from 200 to 535.5 kHz. The types of transmission available are cw and modulated cw (mcw), with either automatic four-letter Morse code identification signals or manually coded signals. The frequency selection, mode of operation (cw, mcw, or manual key), and the identification codes are selected on the front panel of the transmitter. Tactical or semifixed modes are selected on the front panel of the amplifier.

a. The rf signal generated in the transmitter is applied to three high level class B amplifiers (power amplifier-power supplies). The PUSH TO TURN switch selects the mode of operation. In the tactical mode, one of the three power amplifier-power supplies provides 60 watts output power. In the semifixed mode, all

three power amplifier-power supplies provide a total of 180 watts output power. The audio and lockout logic signals are applied through the AUDIO connector to modulate the amplifier and control filter selection. In the tactical mode, the PUSH TO TURN switch couples the output of any one of the power amplifier-power supplies to the amplifier antenna coupler. In the semifixed mode, the PUSH TO TURN switch serially combines all three power amplifier-power supplies and applies the total output (180 watts) to the amplifier antenna coupler.

2-22. Power Amplifier-Power Supply

(fig. 2-27 and FO-23)

The power amplifier-power supply provides 60 watts of rF carrier and is capable of 100 percent modulation. The transmitter supplies a 4 ± 1 watt signal to the INPUT rF connector on the front panel, which distributes approximately 1.3 watts to each of the three power amplifier-power supplies. Each power amplifier-power supply contains two push-pull amplifiers consisting of an RF driver and an rf amplifier final stage.

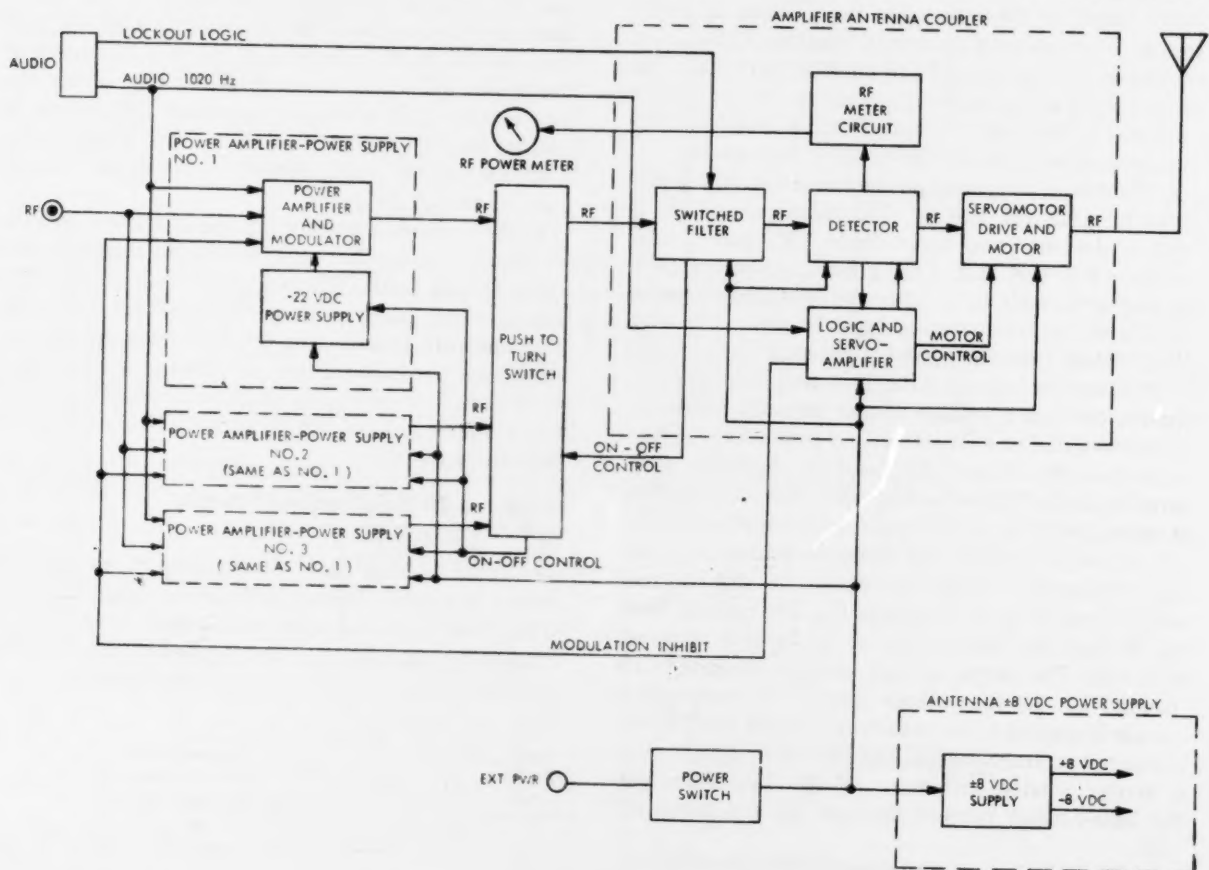
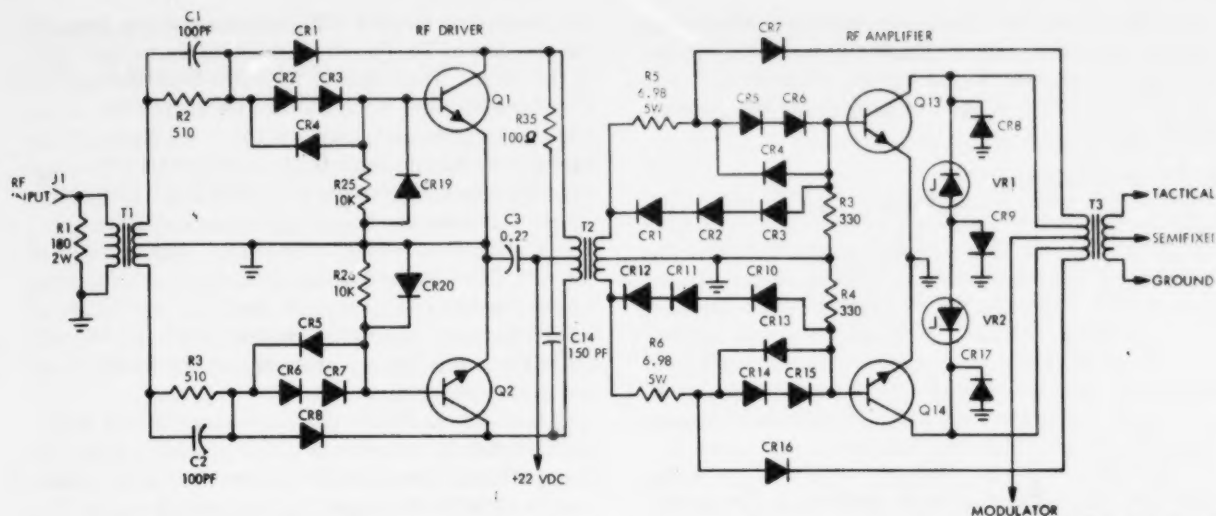


Figure 2-26. Amplifier, Block Diagram.



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Figure 2-27. Power Amplifier-Power Supply, Functional Schematic Diagram.

a. *Rf Driver* (fig. FO-24). The push-pull driver buffers and amplifies the input 1.3-watt signal to 3 watts to drive the rf amplifier stage. The input signal, applied across impedance matching resistor R1, is coupled through transformer T1 to the driver amplifier circuit consisting of transistors Q1 and Q2, a push-pull amplifier stage. The base currents of Q1 and Q2 are limited by resistors R2 and R3. Speed-up capacitors C1 and C2 increase the transistor switching speed. The saturation of Q1 and Q2 is prevented by clamp circuits consisting of diodes CR1, CR2, and CR3, and CR6, CR7, and CR8, respectively. The clamp circuit prevents Q1 from becoming saturated by maintaining the emitter-collector voltage between +1.3 and +1.5 vdc. When the voltage starts to drop below these limits, the base current is shunted through CR1 into the collector, thereby preventing Q1 from saturating. Transistor Q2 is prevented from saturating the same way using CR8. Diodes CR4 and CR5 provide a current path to turn Q1 and Q2 off. Resistors R25 and R26 are dc ground returns for the bases of Q1 and Q2. Reverse base-emitter breakdown is prevented by shunting the reverse base voltage with CR19 and CR20. The output signal is coupled through transformer T2 to the rf amplifier stage.

b. *Rf Amplifier* (fig. FO-23 and FO-25). The class B push-pull final rf amplifier stage amplifies a 3-watt input signal to 60 watts. The input signal is applied to transistors Q13 and Q14 through resistors R5 and R6, which also limit base current. Diodes CR4 and CR13 provide a current path to turn Q13 and Q14 off. Saturation is prevented by the clamp circuit consisting of diodes CR7, CR5, and CR6 for Q13, and the feedback winding on T3, which is connected to diode CR7. A similar circuit consisting of CR14, CR15, and CR16,

and the other feedback winding of T3, prevents saturation of Q14. The emitter-collector voltage of Q13 and Q14 during conduction is +3.5 to +5.5 vdc. During the tuning cycles when the coupler is untuned, the collector voltages tend to go negative. This condition is prevented by diodes CR8 and CR17. VR1 and VR2 protect the collectors from voltage transients greater than 100 volts. The modulation signal is applied through the primary center tap on transformer T3 to the collectors of Q13 and Q14. The output of the amplifier is coupled through T3 to the antenna circuits.

c. The rf signal from the selected power amplifier-power supply is applied through the switched filter to the detector. The filter is electromechanically selected. During the switching process, the power supply section of each power amplifier-power supply is turned off. When the proper filter is selected, the power supplies are turned on. The detector compares the voltage-current phase relationship of the output signal from the switched filter. Any out-of-phase condition produces a signal that is applied to the servo logic. This signal is converted to a dc voltage in the servoamplifier and drives the antenna tuning motor. A voltage is also generated in the servo logic which inhibits the modulation, during the tuning cycle, to the power amplifiers. The servoamplifier drives the motor in either direction, depending on the voltage-current phase relationship in the detector. As the antenna nears resonance, the phase difference in the detectors nears zero. At a preset antenna current, a signal from the detector enables modulation of the power amplifier-power supplies.

c. The rf signal is applied to a top loaded monopole antenna. The antenna is a straight multisection 60-foot mast.

d. The voltages for the power amplifiers are developed by individual power supplies in each power amplifier-power supply. The ± 8.0 vdc used throughout the amplifier are developed in a regulated low voltage power supply.

2-23. Modulator

(fig. 2-28 and FO-23, FO-24, and FO-25)

The modulator provides a 40-watt sinusoidal 1020-Hz waveform to the collectors of the rf final push-pull amplifiers Q13 and Q14. The transmitter provides a 1-milliwatt signal, through the AUDIO connector on the front panel, that divides across the three modulators to produce an input signal of 0.33-milliwatt. Each modulator contains a modulation driver, modulation final, and a modulation disable stage.

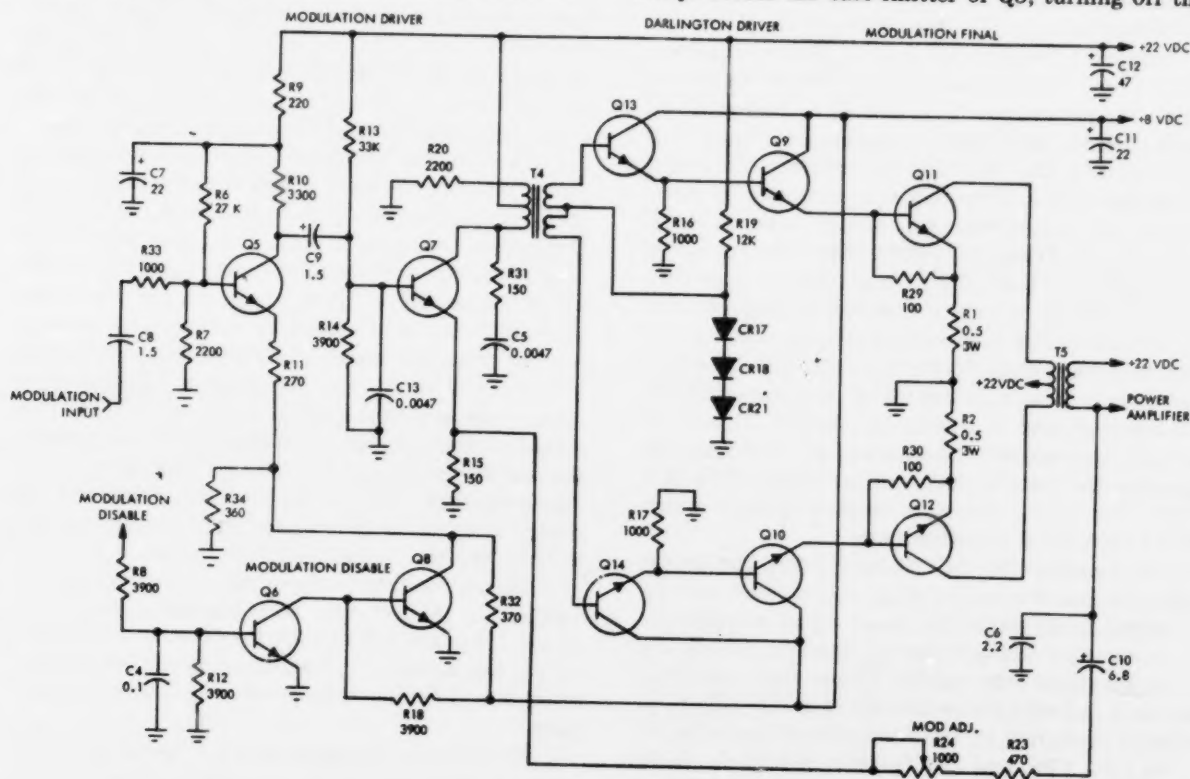
a. *Modulation Driver.* The modulation driver contains two single-ended class A amplifiers. The input signal is amplified to 200 milliwatts to drive the modulation final stage. The input signal is coupled through capacitor C8 and resistor R33 to class A single-ended amplifier Q5. This amplifier provides a stable voltage gain and stable input impedance to the modulator. Resistors R6, R7, and R11 form the biasing network and resistor R9 with capacitor C7 provide power supply isolation. The signal at the collector of Q5 is coupled through capacitor C9 to single-ended class A amplifier

Q7. Swamping resistor R20 balances the bias through the primary of T4, thereby stabilizing the voltage gain of the circuit. The negative feedback from the secondary of transformer T5 to the emitter of Q7 reduces the signal distortion and stabilizes the overall gain of the modulator. Modulation adjust potentiometer R24 controls the amount of feedback applied to Q7. Capacitor C5 and C13 limit the bandwidth of the amplifier.

b. *Darlington Driver.* The input signal coupled through T4 is applied to the Darlington driver stage, which consists of a push-pull amplifier consisting of Q13, Q9, Q14, and Q10. Diodes CR17, CR18, and CR21 form the biasing network for the driver stage and the final stage.

c. *Modulation Final.* The final stage of the modulator consists of transistors Q11 and Q12, a Class AB push-pull amplifier. This circuit has emitter degeneration to improve the distortion and stabilize gain. The output is coupled through transformer T5 to the rf amplifier in the power amplifier.

d. *Modulation Disable.* This circuit, composed of transistors Q6 and Q8, disables the modulator on command from the antenna coupler during the tuning cycle. A +4.5 vdc signal from the servo logic is applied to the base of Q6. This voltage causes Q6 to conduct and turns off Q8. When Q8 turns off, a reverse bias develops across the base-emitter of Q5, turning off the



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Figure 2-28. Modulator, Functional Schematic Diagram.

modulation driver.

2-24. +22 Vdc Power Supply

(fig. 2-29, 2-30, FO-23, and FO-26)

The three power amplifier-power supplies each contain a +22 vdc power supply connected in parallel to the external power source. The power supply uses switching regulator circuits and converts the input voltage into regulated +22 vdc. The +22 vdc is used in the rf amplifier and modulator stages.

a. The +28 vdc input voltage is filtered by capacitors C1 and C4, and applied through resistor R1 to Zener diode VR1, which provides a stable voltage to the base of transistor Q1. Q1 supplies the reference voltage to AR1 through resistor R8 and Zener diode VR2. The output voltage is sampled at the voltage divider network consisting of resistors R9, R10, and RT1, and applied to the inverting input of AR1.

b. During initial turn-on, the reference voltage exceeds the sampling voltage and drives the output of AR1 positive, which turns on transistor Q3 through current limiting resistor R6. Current then flows through transistors Q4 and Q5 and current limiting re-

sistor R5. Capacitor C6 decreases the turn-on time for Q4 and Q5. When Q4 and Q5 start to conduct, capacitors C9, C10, C11, C12, and C14 start to charge through inductor L1. As the voltage increases, a sample of this voltage is applied to the negative input to AR1.

d. When Q4 and Q5 stop conducting, the voltage across L1 reverses polarity and the current is discharged through diode CR2 and the output load. As the inductor current decreases, the load current is supplied by C9, C10, C11, C12, and C14, and the output voltage begins to decrease. When the reference voltage again exceeds the sampling voltage, the cycle starts over. The cycle repeats at a rate determined by the in-

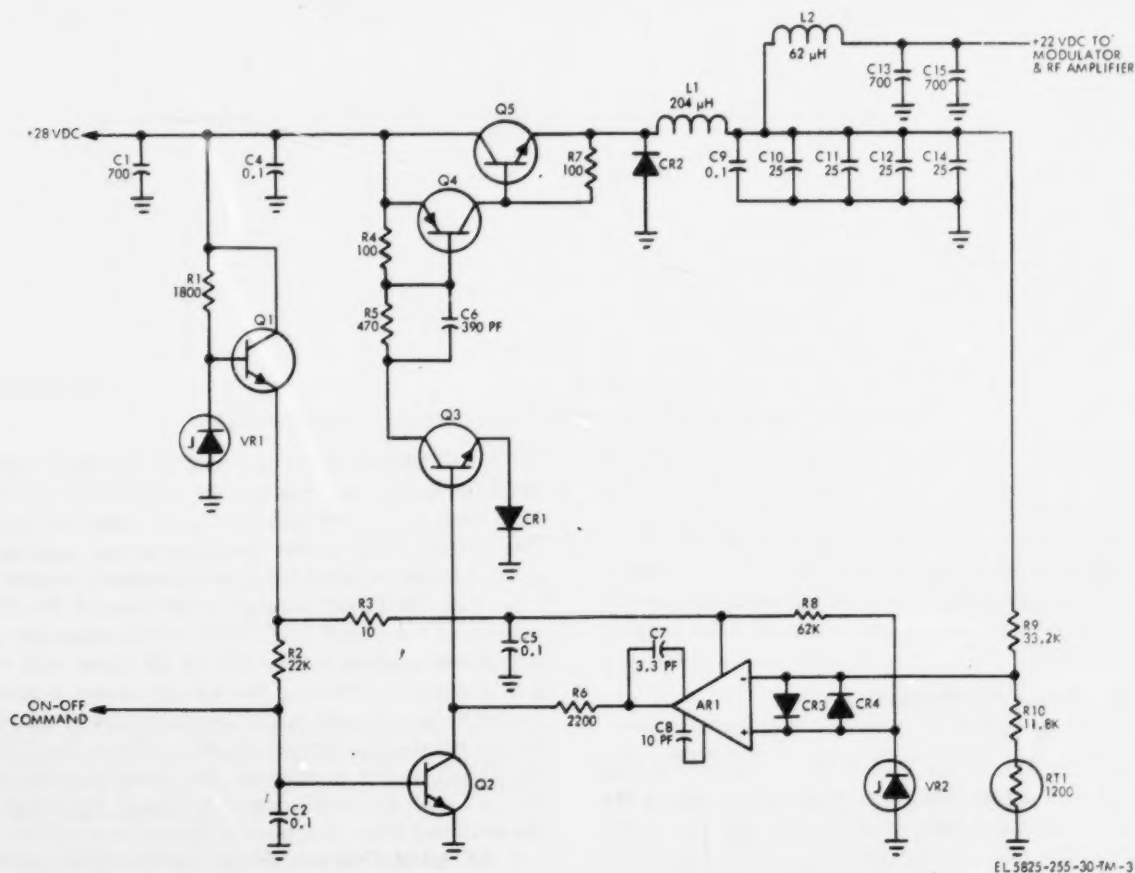


Figure 2-29. +22 Vdc Power Supply, Functional Schematic Diagram.

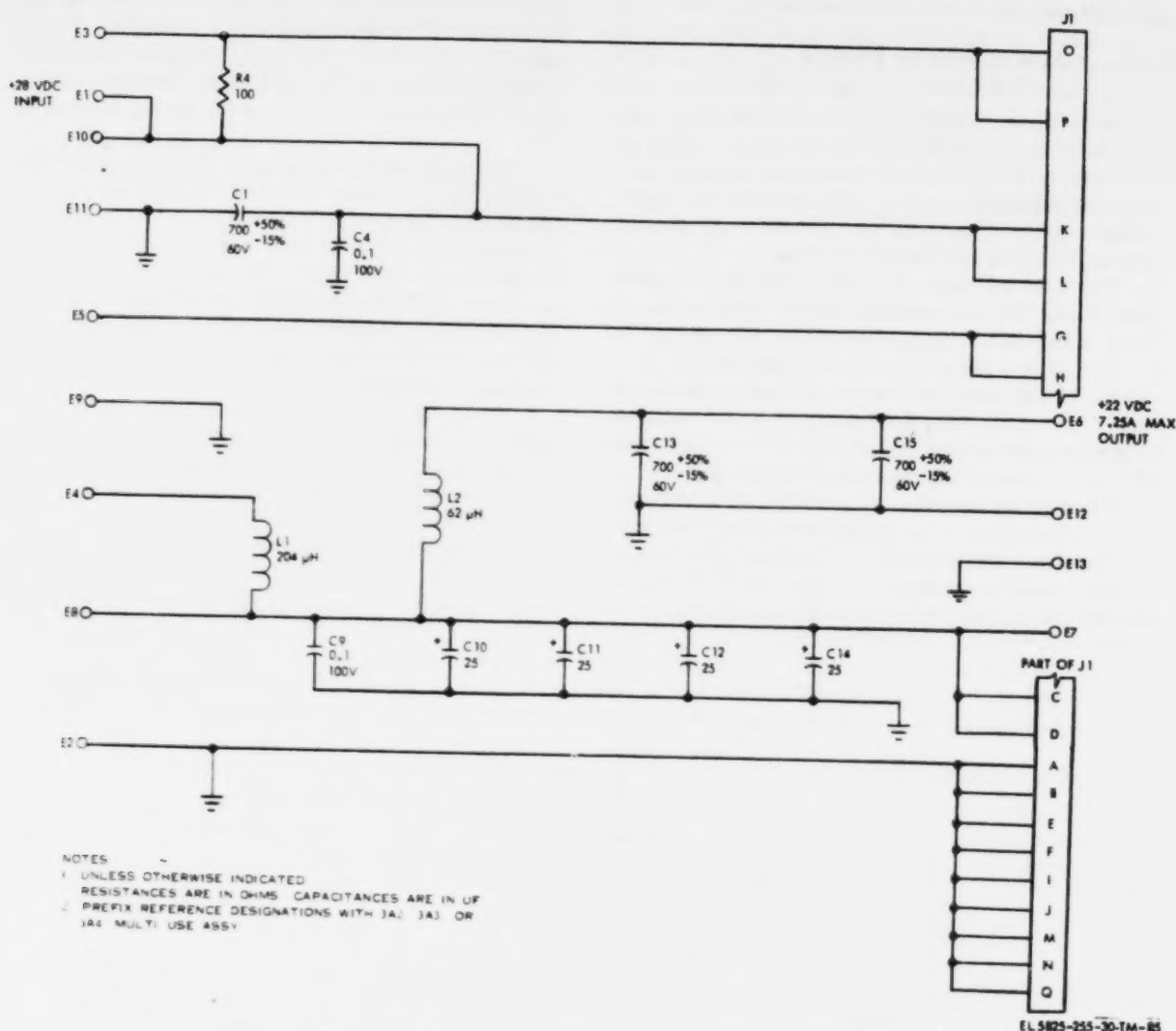


Figure 2-30. +22 Vdc Power Supply 3A2A2, 3A3A2, or 3A4A2, Interconnect Diagram.

put voltage and the output load. The +22 vdc output is filtered by inductor L2 and capacitors C13 and C15, which reduce the ripple generated by switching action.

e. During the filter switching periods, an on-off command signal is applied from the switched filter to turn on transistor Q2. Transistor Q2 turns off the +22 vdc supply by grounding the output of AR1, keeping Q3 turned off.

2-25. PUSH TO TURN Switch

(fig. 2-31)

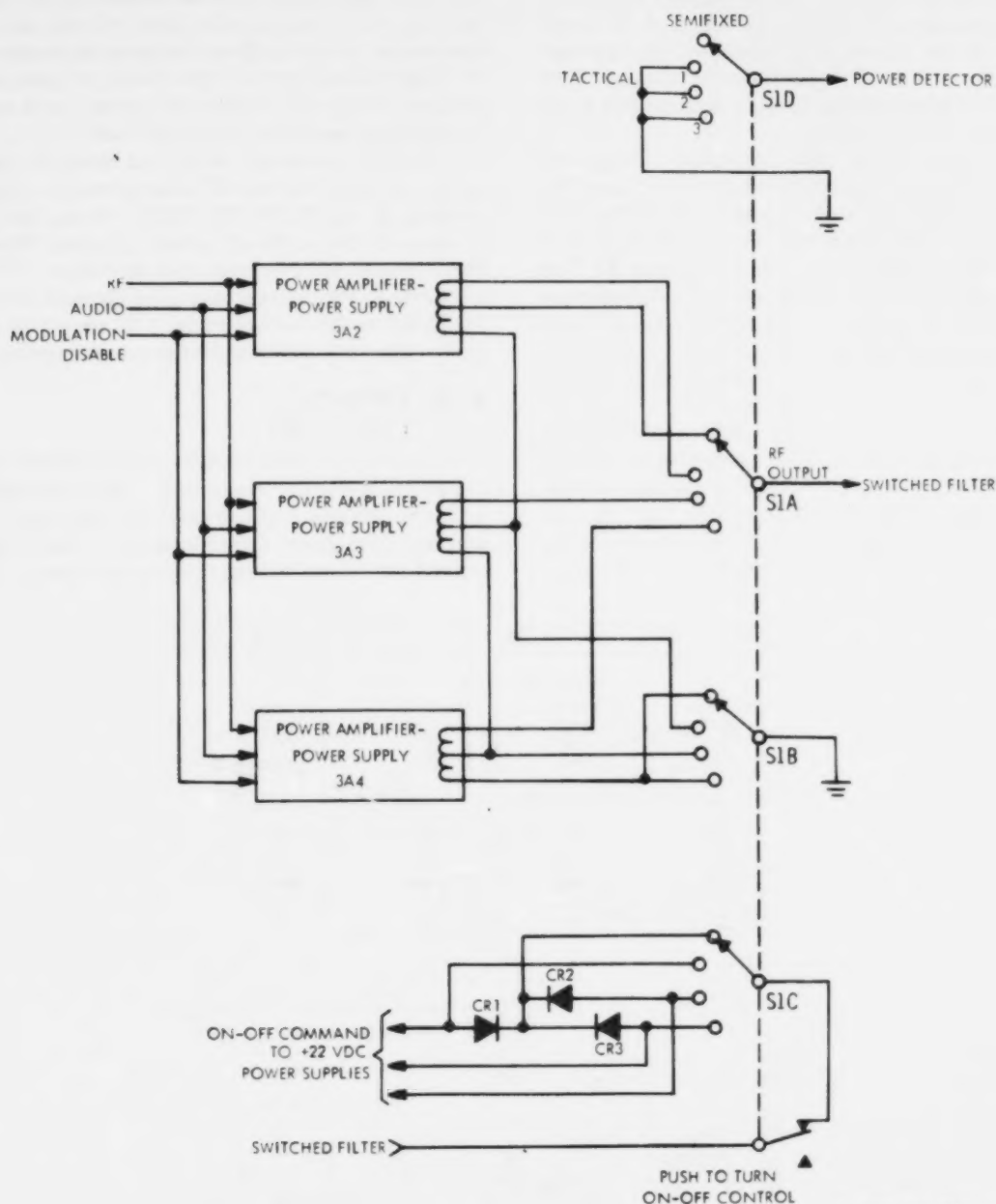
The PUSH TO TURN switch is a four-deck rotary switch that selects the mode of operation, routes the on-off command to one or all of the +22 vdc power supplies, and controls the inputs to the RF meter.

a. *Mode of Operation.* The PUSH TO TURN switch (S1A and S1B) selects the mode of operation, TAC-

TICAL or SEMIFIXED. Any one of the three power amplifier-power supplies may be selected for the tactical mode and all are selected for the semifixed mode. The output of the power amplifier-power supplies is applied to the switched filter in the antenna coupler.

b. *+22 Vdc Power Supply On-Off Control.* The S1C portion of the PUSH TO TURN switch routes the on-off control signals to any one or all three +22 vdc power supplies. Pushing the switch causes a micro-switch to be activated, which keeps the power supplies turned off during manual selection. When the PUSH TO TURN switch is released, the power supplies are held off until the on-off command signal, generated in the switched filter, is applied to the power supplies.

c. *RF Meter Control.* The PUSH TO TURN switch routes the +28 vdc through section S1D to energize relay K1 in the detector when the equipment is operat-



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Figure 2-31. PUSH TO TURN switch. Functional schematic diagram.

ing in the tactical mode. Energizing the relay shunts a resistor across the rf power meter drive circuit for the proper deflection in the tactical mode. In the semifixed mode, the relay is deenergized.

2-26. Amplifier Antenna Coupler

The amplifier antenna coupler automatically tunes the 60-foot antenna to resonance. The amplifier antenna

coupler consists of a switched filter, detector, logic and servoamplifier, and a servomotor drive.

2-27. Amplifier Switched Filter

(fig. 2-32, FO-27, 2-33, and 2-34)

The switched filter selects the proper bandpass filter to match the impedance of the antenna and to attenuate harmonics. The filter consists of two subassem-

blies. The first contains the four bandpass filters and a four-position, three-deck rotary switch, S1A, S1B, and S1C. The second subassembly consists of an am amplifier which drives an intermittent 12-step dc motor, and the circuit which generates the on-off command signal for the +22 vdc power supplies.

a. *Bandpass Filters.* The bandpass filters are selected electromechanically through the action of the intermittent drive controlled by logic signals from the lockout logic in the transmitter. The logic signals drive the dc motor to control filter selection switch S1. The input rf signal is filtered to pass the selected frequency and attenuate the harmonics. The filter outputs match the varying antenna load resistances to the amplifier impedance. The rf out-put from the filter is applied through switch S1B to the detector.

b. *Filter Selection.* When the operator selects a frequency on the front panel of the transmitter, a logic 1 signal (+2.5 to +5.0 vdc) is applied through switch S1A. This high corresponds to one of the four frequency ranges of the bandpass filters. When one of the inputs is high (open), the other three are low (ground).

The high input signal turns on transistors Q1, Q2, Q3, and Q4, which amplify the input current enough to operate the dc motor. The motor steps in increments of 30 degrees until switch S1A finds its open-seeking position. When this occurs, the motor stops and the correct input bandpass filter is selected.

c. *On-Off Command.* While the motor is running transistor Q5 is turned off. This presents a high impedance to the PUSH TO TURN switch, deck S1C, turning off the +22 vdc power supplies. When the motor stops, Q5 conducts and develops -0.7 vdc across CR3. This voltage is applied through the PUSH TO TURN switch to turn on the +22 vdc power supply in the respective power amplifier-power supplies.

2-28. Detector

(fig. FO-28)

The detector provides antenna tuning information to the servo logic in the transmitter. This is accomplished with two circuits, a power level detector and a phase detector. The power detector provides digital data to control the coarse tuning at discrete antenna current

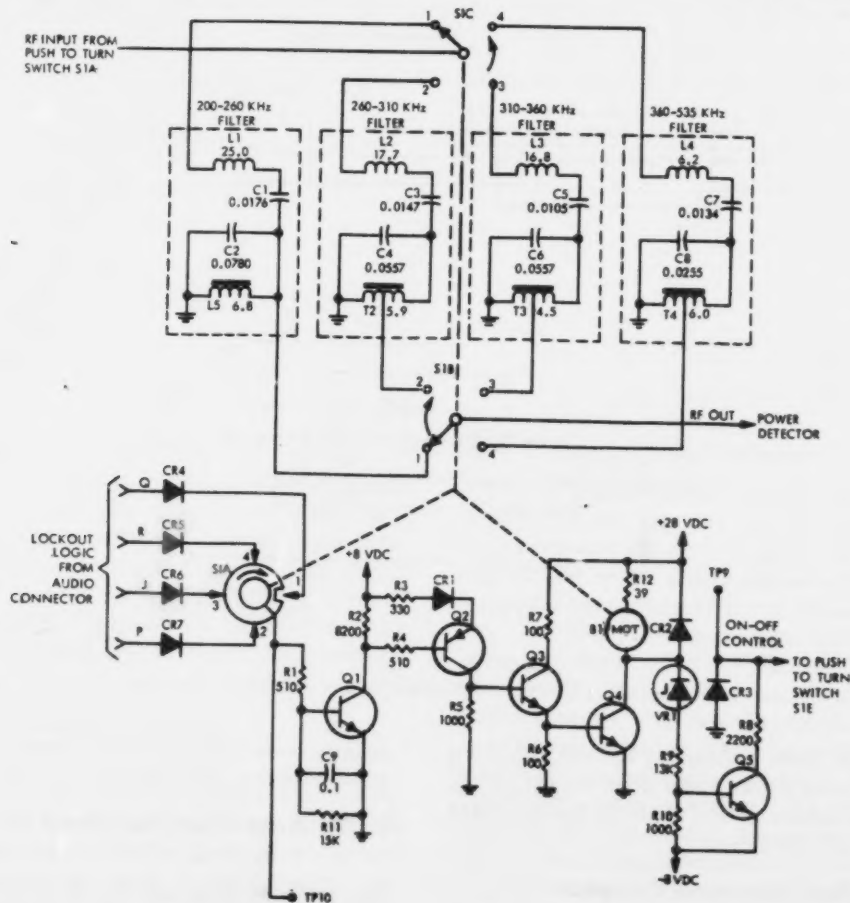
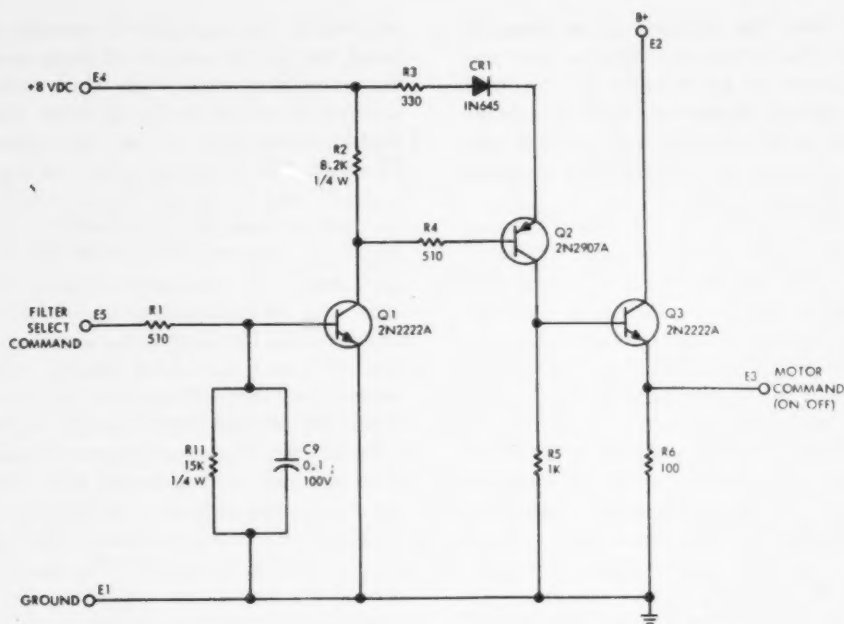


Figure 2-32. Amplifier Switched Filter, Functional Schematic diagram.

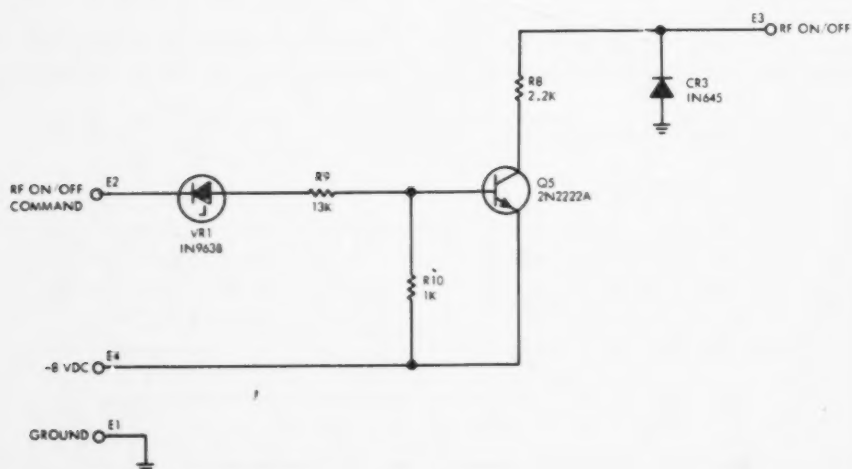


NOTES

1. UNLESS OTHERWISE INDICATED, RESISTANCES ARE IN OHMS. CAPACITANCES ARE IN UF.
2. PREFIX REFERENCE DESIGNATIONS WITH A1.

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Figure 2-33. Switched Filter No. 1 3A5A1, Schematic Diagram.



NOTES

1. UNLESS OTHERWISE SPECIFIED, RESISTOR VALUES ARE IN OHMS $\pm 1\%$ 1/4W.
2. PREFIX REFERENCE DESIGNATIONS WITH A2.

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Figure 2-34. Switched Filter No. 2 3A5A2, Schematic Diagram.

levels to indicate when the antenna is far from, or nearing, resonance. The power level detector also provides the signal current to an rf meter on the front panel to indicate antenna resonance. The phase detector produces a logic signal when the antenna is within ± 45 degrees of resonance and controls the antenna tuning motor during final tuning.

a. **Power Level Detector** (fig. 2-35). The rf current into the antenna is coupled by transformer T2, rectified by diode CR5, and filtered by C7, R20, and C8. The voltage divider network, consisting of resistors R21 and R22, provides the voltage to operational amplifier AR3. Resistors R25 and R26 form a fixed biasing network for AR3. When the input current is less than 0.46 ampere in the tactical mode, or 0.7 ampere in the semifixed mode, the biasing voltage exceeds the sample voltage and the output of AR3, the low/high power signal, becomes a logic 0. When the input current reaches or exceeds this limit, the sample voltage causes the output of AR3 to become a logic 1. Capacitors C11, C12, and C13 are rf bypass capacitors. In the meter circuit, diode CR7 and resistor R23 form a clamping circuit which prevents the rf meter needle from pegging. Relay K1 is controlled by the PUSH TO TURN switch on the front panel, is activated in the tactical mode, and controls the sensitivity of the RF meter. When the antenna is resonant, the meter needle is in the green zone.

b. **Phase Detector** (fig. 2-36). The rf current into the antenna is sampled through transformer T1. The rf voltage is sampled at filter select switch deck S1B. The rf signals are fed into operational amplifiers AR1 and AR2, which produce square wave outputs. The signals are then fed into flip-flops U1A and U1B, where the frequency of the incoming signals is divided by two. Gate U2A and the rc time constant network of

resistor R7 and capacitor C3 provide the desired dead band, that is, the amount of phase error allowed from the actual zero phase angle of the voltage and current waveforms as seen by the detector. Gate U2B ensures that U1A and U1B are not 180 degrees out-of-phase. Flip-flop U3A is cleared when the signal from rc network R7 and C3 is low. Flip-flop U3B and transistor Q1 form a one-shot multivibrator which presets U3. Flip-flops U4A and U4B are driven by the outputs of U1A and U1B, and provide the information to the logic and servoamplifier that determines if the antenna tuning motor should run cw, ccw, or stop. Flip-flop U5 stores the motor control information and is cleared by U3A. When the two waveforms are in phase, the outputs from U5A and U5B are logic 1. This indicates that the antenna is at resonance and signals from the logic and servoamplifier stop the motor. If the load is too inductive, indicating that the voltage leads current, the output from U5A is logic 0 and the output of U5B is logic 1. The motor is then driven ccw. If the load is too capacitive, the outputs are reversed and the motor is driven cw.

2-29. Logic and Servoamplifier (fig. FO-29 and FO-30)

The logic and servoamplifier control the speed and direction of the antenna tuning motor and generate a modulation inhibit voltage when the antenna is tuning. When a large tuning error occurs, the modulation inhibit command is generated and the antenna servomotor is driven at maximum speed, driving the antenna tuning inductor towards maximum inductance. When maximum inductance is reached, an end-stop microswitch is tripped and the motor direction is reversed toward minimum inductance and its speed is reduced to medium. When the antenna is tuned within

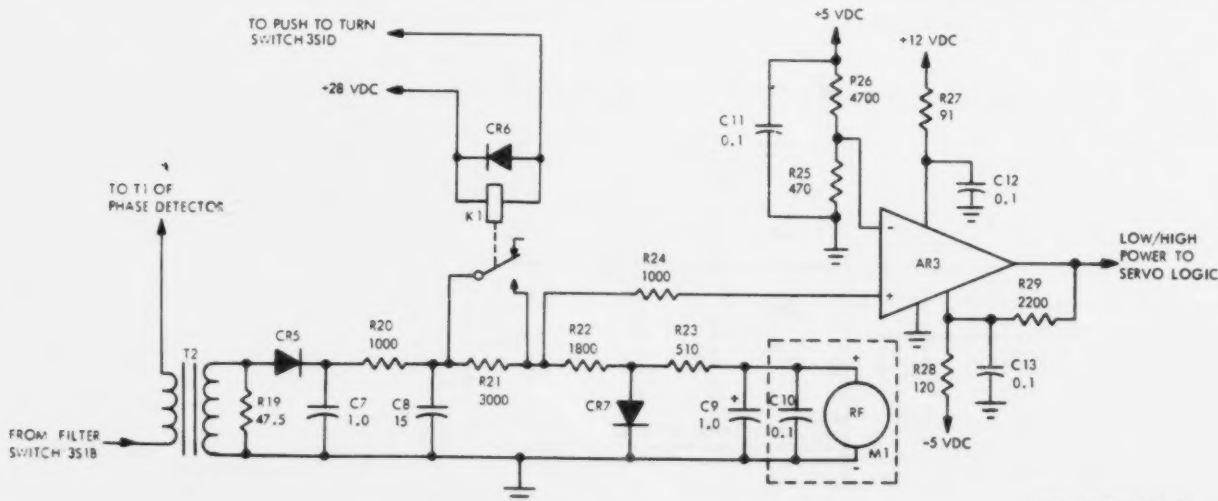


Figure 2-35. Power Level Detector, Functional Schematic Diagram.

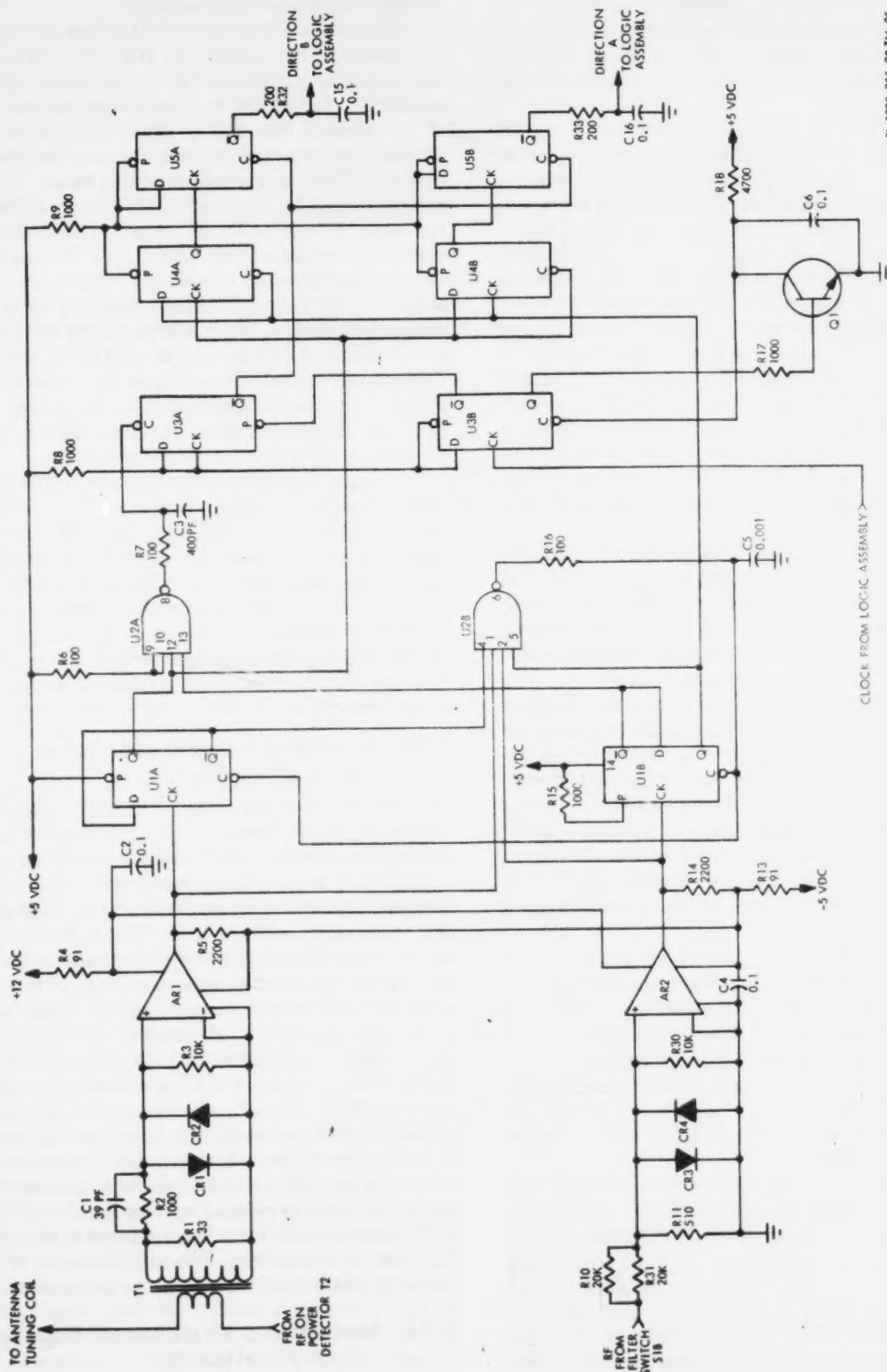


Figure 2-36. Phase Detector, Functional Schematic Diagram.

± 45 degrees of resonance, modulation is enabled and the motor drives the tuning inductor at creep speed, controlled by the signals from the phase detector. When the antenna has reached resonance, the motor is stopped.

a. *Power Detector Logic.* The power detector logic circuit consists of flip-flop Z2A. When a large tuning error occurs, the low/high power signal is a logic 0, thereby reversing the Q output of Z2A. The low Q output sets the output of gate Z3C high and turns on transistors Q5 and Q6, the modulation inhibit command circuit. The high Q output from Z2A sets the end-stop switch logic circuit Z2B and drives the servomotor at maximum speed, moving the antenna tuning inductor towards maximum inductance. The high Q output of Z2A also changes the output of the square wave generator from low to high duty cycle. The high duty cycle clocks the servoamplifier circuits to drive the motor at medium speed. During the initial tuning, the medium speed control is overridden by the low input to steering gate Z4A from the end-stop logic gate Z3A.

b. *End-Stop Switch Logic.* The end-stop switch logic circuit consists of flip-flop Z2B and gates Z3A and Z3D. When inductor reaches maximum inductance, end-stop switch A is toggled and grounds the input of Z2B. The low input clears Z2B and reverses its outputs. The low Q output drives gate Z3A high, turning off servoamplifiers Q7 and Q8 and turning on servoamplifier driver transistors Q9 and Q10, reversing the driving direction of the motor. The motor drives the antenna tuning inductor towards minimum inductance at medium speed. When the antenna is tuned within ± 45 degrees of resonance, the low/high power signal, to the power detector logic circuit, goes high. At the next clock pulse, Z2A is clocked set, Z2B is reset, and the duty cycle goes to low to provide creep speed.

c. *Motor Direction Logic.* The motor direction logic circuits control the direction of the motor during final tuning of the antenna. A small tuning error will input a low to either Z4C or Z4D. When the input to direction A is a logic 0, Z4D, Z5B, and Z4A turn off Q7 and Q8. The motor is then driven at creep speed in direction A or towards maximum inductance. When the direction B input is low, the motor is driven toward minimum inductance.

d. *Audio Detector.* The audio detector circuit consists of transistors Q1 through Q4 and gate Z3C. When the audio is applied to the detector, gate Z3C inhibits the motor drive information to Z5A and Z5B. If the audio is applied when resonance is within ± 45 degrees, the modulation is enabled. The high output of Z3C inhibits the motor control signals to Z4A and Z4B, and to the servoamplifier. When the audio is off, Z3C enables Z5A and Z5B, allowing the motor drive

direction signals to drive the motor.

e. *Square Wave Generator.* The square wave generator consists of transistors Q11 and Q12, ramp generator unijunction transistor Q13, and differential comparator Z6. The square wave generator operates at one of two variable duty cycles, which controls the speed of the servomotor and provides the clock for the phase detector. When an in-phase condition exists, the low Q output from Z2A turns off Q12. The resulting high reference voltage at Z6 is compared with the ramp voltage generated across C12 and Q13. The high reference voltage allows Z6 to operate for approximately 30 percent of the time, producing a low duty cycle or the creep speed control. When a large tuning error occurs, the Q output of Z2A goes high and Q12 is turned on. This reduces the reference voltage on Z6 and the comparator operates for approximately 80 percent of the time. The longer operation provides a high duty cycle for medium speed control of the servomotor.

f. *Voltage Regulation.* The voltage regulation circuits consist of voltage regulator VR1, VR2, and Zener diode regulator CR3. Regulator VR1 provides a regulated +12 vdc from the +28 vdc unregulated input voltage. Regulator VR2 provides a regulated +5 vdc from the +8 vdc power supply. Zener diode CR3 provides a regulated -5 vdc from the -8 vdc power supply. The regulated voltages provide the operational voltages for the logic and servoamplifier, and the phase detector.

2-30. Amplifier Servomotor Drive (fig. 2-37 and FO-31)

The purpose of the servomotor drive is to drive the tuning motor. Servomotor B1 is connected with a shaft to the variable tap on inductor L1. When a large tuning error occurs, the phase detector logic signals from the logic assembly turn on servoamplifier Q1 and Q2, which apply +28 vdc to B1. The motor drives the tap on L1 at full speed towards maximum inductance (A). A counter switch, also connected to the shaft, counts off the revolutions of the shaft. When the tap on L1 reaches point A, the counter switch trips end-stop switch 1, which removes the +28 vdc from the motor. The end-stop switch logic from the logic and servoamplifier turns on servoamplifier Q3 and Q4, which reverses the motor and drives the tap on L1 at medium speed towards minimum inductance (B). When the antenna is within ± 45 degrees of resonance, the motor speed is reduced to creep speed and the tap on L1 is controlled by the phase detector logic from the logic and servoamplifier. When the antenna is tuned and an in-phase condition exists, the motor stops.

2-31. Amplifier ± 8 Vdc Power Supply (fig. 2-38 and FO-32)

The amplifier ± 8 vdc power supply is a switching type

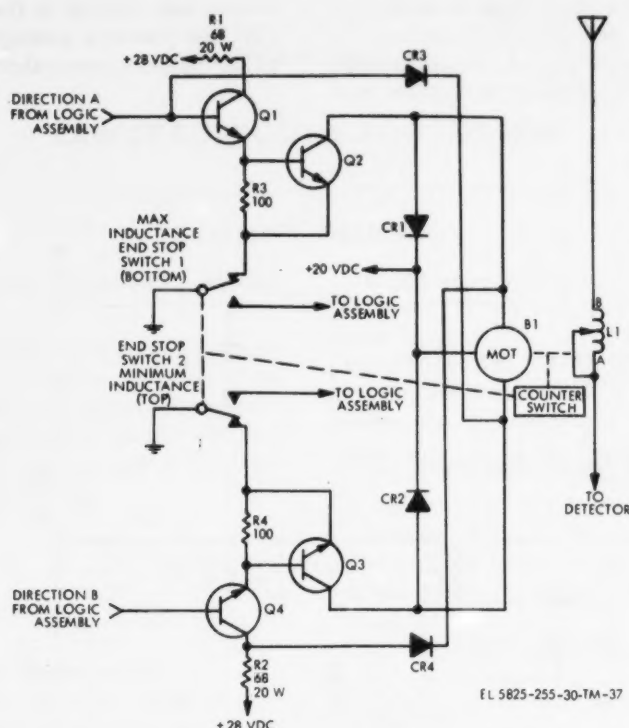


Figure 2-37. Amplifier Servomotor Drive, Functional Schematic Diagram.

of regulated power supply. The -8 vdc power supply is derived from a transformer in the $+8$ vdc output line before filtering.

a. The input voltage is applied through resistor R1 to Zener diode VR1, which provides a stable voltage at the base of transistor Q1. Transistor Q1 supplies the operating voltage for AR1. The reference voltage for AR1 is provided by resistor R6 and Zener diode VR2. A sample of the output voltage is derived from the voltage divider consisting of resistors R7 and R8.

b. During the initial turn-on, the reference voltage exceeds the sampling voltage and drives the output of AR1 positive, which turns on transistor Q2 through current limiting resistor R5. Current then flows through transistor Q3 and current limiting resistor R3. Capacitor C14 increases the turn-on time of Q3. When Q3 conducts, capacitors C9, C10, and C11 start to charge through the primary of transformer T1. As the voltage increases, a sample of this voltage is applied to the negative input of AR1.

c. When the sampling voltage exceeds the reference voltage, AR 1 is driven negative, which turns off Q2 and Q3. Diode CR1, in series with the emitter of Q2, provides an extra +0.6 vdc that prevents Q2 from conducting due to spurious signals from the output of AR1. Resistor R2 provides the quick turn-off time for Q3. AR1 is protected from high input voltage spikes by diodes CR5 and CR6. Capacitors C4 and C5 provide

frequency stabilization of AR1.

d. When Q3 stops conducting, the voltage across the primary of T1 reverses polarity and the current is discharged through diode CR2 and the load. As the inductor current decreases, the load current is supplied by C9, C10, and C11 and the output voltage begins to decrease. When the reference voltage exceeds the sampling voltage, the cycle starts over. The cycle repeats at a rate determined by the input voltage and the output load. The +8 vdc output is filtered by inductor L1 and capacitor C13, which reduces the ripple generated due to switching action.

e. Due to the fluctuating current in the primary of T1, an alternating voltage is induced in the secondary. This voltage is rectified by diodes CR3 and CR4 and charges capacitors C3 to a negative voltage. This voltage is applied through temperature compensating resistors RT1 and RT2 to hybrid voltage regulator VR3, providing a -8 vdc output. Capacitor C12 filters the ripple from switching actions. Thermistors RT1 and RT2 protect the regulator from current surges and C7 is a stabilizer capacitor.

2-32. Input Line Filter (fig. FO-33)

The input line filter assembly provides filtration of the input power and overcurrent and overvoltage protection for the amplifier. The input power is applied

through J1 to an inductive-input filter consisting of inductors L1 and L2 and capacitor C9. Capacitors C1 through C8 bypass stray rf to ground. Circuit breaker CB1 and Zener diode VR1 prevent overcurrent and

overvoltage damage to the amplifier. Circuit breaker CB1 also prevents damage to the power source if amplifier failure causes a short circuit to ground.

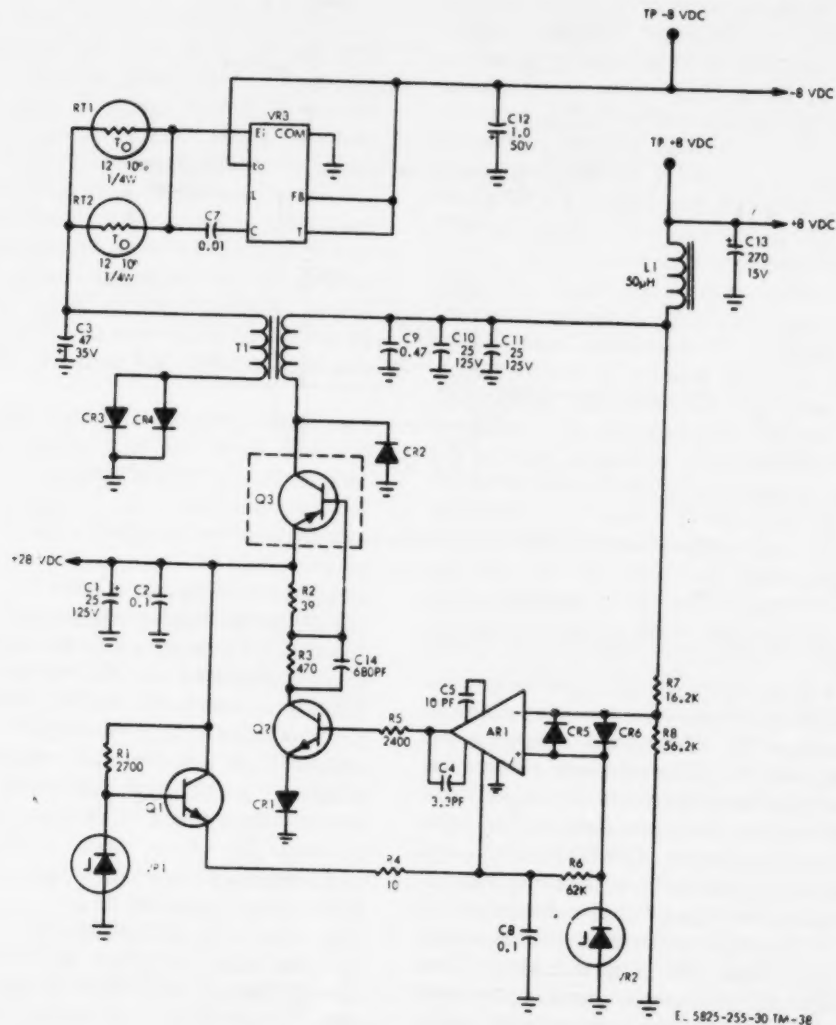


Figure 2-38. Amplifier ± 8 Vdc Power Supply, Functional Schematic Diagram.

CHAPTER 3

DIRECT SUPPORT MAINTENANCE

Section I. GENERAL

3-1. Scope of Direct Support Maintenance

a. *General.* The maintenance duties assigned to personnel at direct support maintenance are listed below with a reference to the paragraph covering the specific maintenance function. Maintenance functions beyond the scope of direct support maintenance shall be referred to depot maintenance.

Maintenance function	Paragraph
Troubleshooting	3-4
Adjustments	3-16 through 3-19
Removal and replacement procedures	3-20
Testing procedures	3-26

b. *Voltage and Resistance Measurements.*

(1) *Voltage measurements.* This equipment is transistorized. When measuring voltages, use tape or sleeving (spaghetti) to insulate the entire test probe, except for the extreme tip. A momentary short circuit can ruin transistors.

CAUTION

Before using any ohmmeter to test transistors or transistor circuits, measure the open-circuit voltage across the ohmmeter leads with another meter. Do not use the ohmmeter if the open-circuit voltage exceeds 1.5 volts. Also, since the Rx across the test leads, the comparatively high current (50 milliamperes or more) may damage the transistor under test. The Rx1 range of any ohmmeter should not be used when testing low power transistors.

(2) *Resistance measurements.* Make resistance measurements in this equipment only as directed, otherwise the indications obtained may be inaccurate.

b. *Waveforms.* Voltage readings in some circuits would be difficult if not impossible, to analyze because they would vary with frequency, codes sent, and circuit conditions during different modes of equipment operation. For these circuits, waveforms must be observed and compared with waveforms provided with the testing and troubleshooting charts.

NOTE

Continuity, relay sequence and relay timing tests are not applicable.

c. *Bench Testing.* Refer to section V for bench testing procedures.

d. *Resistor, Inductor, and Capacitor Color Code Diagram.* The resistor, inductor, and capacitor color code diagram (fig. FO-1) is provided to aid maintenance personnel in determining the value, voltage rating, and tolerance of military standard resistors, inductors, and capacitors.

3-2. Standard Tools and Test Equipment

Refer to TM 11-5825-255-30P and the maintenance allocation chart in TM 11-5825-255-12 for a list of the standard tools and test equipment authorized for direct support maintenance. These items are also listed below:

a. *Standard Tools.*

Nomenclature	Common name
Tool Kit, Electronic Equipment TK-100/G	
Tool Kit, Electronic Equipment TK-105/G	
Maintenance Kit, Electronic Equipment MK-696/A	
Torque wrench (5-150 in. lb)	Torque wrench
Torque screwdriver (4-100 in. lb)	Torque screwdriver
Adapter (3/8 in. drive to 1/3 in. drive, female socket)	Adapter
Socket (3/4 in. drive to 3/8 in. drive)	Socket
Screwdriver bit (Phillips #1)	Screwdriver No. 1
Screwdriver bit (Phillips #2)	Screwdriver No. 2
Connector, Adapter UG-274/U	Connector

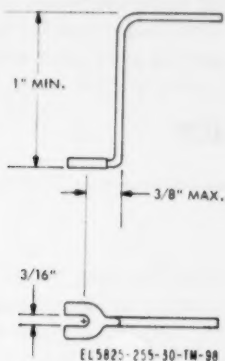
b. *Standard Test Equipment.*

Nomenclature	Common name
Multimeter TS-352B/U	Multimeter
Oscilloscope AN/USM-281A	Oscilloscope
Counter, Electronic Digital AN/USM-207	Counter
Dummy Load DA-75(*)/U	
Voltmeter, Meter ME-30(*)/U	Ac voltmeter
Audio Level Meter TS-585(*)/U	

3-3. Special Tools and Test Equipment

The following special tools and test equipment are required for direct support maintenance:

a. *Special Tools* (fig. 3-1). Only one special tool is required, a special wrench for tightening the antenna RF jack (1A14MP4, fig. 3-21). If no wrench is available that meets the requirements of figure 3-1, a wrench can be manufactured from a standard 3/16-inch open-end wrench as shown. The wrench can be formed by heating the wrench at the points where it must be bent or by cutting the wrench end from the handle and then



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Figure 3-1. Wrench, Antenna RF Jack.

brazing or welding the wrench end to the handle in the required position.

b. *Special Test Equipment.* The special test equipment required is described below:

(1) *Dc power supply.* Any dc power supply that is

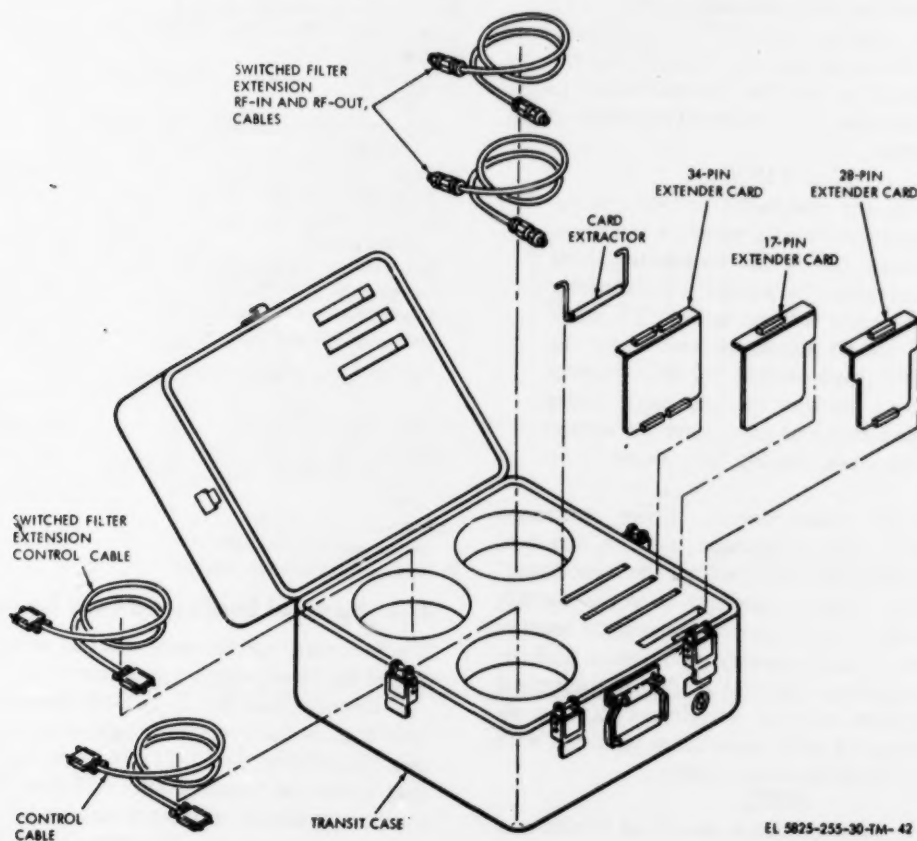
capable of supplying 0 to +15 vdc at 1 ampere and +28 $\pm$ 0.5 vdc at 30 amperes is acceptable.

(2) *Dummy Load DA-639/TRN-30(V).* The DA-639/TRN-30(V) is supplied with Beacon Set, Radio AN/TRN-30(V)1 and is described in TM 11-5825-255-12.

(3) *Radio Beacon Transmitter T-1199/TRN-30(V).* The transmitter provides audio, rf, and control logic signals required by the amplifier during testing and troubleshooting.

(4) *Maintenance Kit, Electronic Equipment MK-1805/TRN-30(V)* (fig. 3-2). The MK-1805 contains a circuit card extractor, three circuit card extender assemblies, and four cable assemblies required to perform direct support testing and troubleshooting. The components of the maintenance kit are contained in a transit case for storage and shipment. The components of the maintenance kit are listed and described below:

Nomenclature	Common name
Card Extractor, SM-C-550708	Card extractor
Card Extender Assembly, 34 Pin, SM-D-550691	34-pin extender card
Card Extender Assembly, 28 Pin, SM-D-550685	28-pin extender card



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Figure 3-2. Maintenance Kit, Electronic Equipment MK-1805/TRN-30(V).

Nomenclature

Common name

Card Extender Assembly, 17 Pin, SM-D-550688	17-pin extender card
Cable Assembly, Control, SM-D-550696	Control cable
Cable Assembly, rf, Switched Filter Extension, SM-C-725876 (2 required)	Switched filter extension rf cable
Cable Assembly, Control, Switched Filter Extension, SM-D-725875	Switched filter extension control cable
Transit Case, SM-D-726032-1	Transit case

(a) The card extractor is a handle with two spring-wire hooks that fit into holes on the exposed edges of circuit cards 1A4 through 1A11 when the circuit cards are installed in the transmitter. To extract a circuit card, insert the extractor hooks into the circuit card holes and pull upward while gently rocking the circuit card side to side until the circuit card is free.

(b) Three extender cards allow circuit cards 1A4 through 1A11 to be operated while extended away from the transmitter interconnect circuit card. The extender cards provide extension of 17 pin, 28 pin, or 34 pin circuit cards and are so identified during the troubleshooting procedures. Test point probe jacks, located on the extender cards and identified with letters that correspond to the connector pins, provide a convenient means of monitoring circuit card performance. To use an extender card, first ensure that power to the transmitter has been turned off. Remove the transmitter cover and then the circuit card to be tested with the card extractor. Use the extender card that corresponds to the number of pins on the connector of the circuit card under test. Carefully insert the extender card into the connector on the interconnect circuit card. Install the circuit card on the top of the extender card, being careful to align the connector pins.

(c) The switched filter extension rf cable and switched filter extension control cable are used during the performance test of the switched filter assembly. Instructions for use of the cables are included in the switched filter performance test. The control cable, although not required in the testing and troubleshooting procedures, is provided for use by direct support maintenance personnel in any secondary maintenance operations that may be required.

(d) The transit case contains polyurethane foam shaped to form a cushion for the maintenance kit assemblies during storage and shipment. An automatic pressure relief valve allows internal and external pressure differentials to be equalized. To use the transit case, position the cables, extender cards, and card extractor as shown in figure 3-2 and carefully close the case. Secure the four latches.

(5) *Dummy Load DA-640/TRN-30(V)* (fig. 3-3).

(a) The dummy load is used in testing and troubleshooting the amplifier. To use the dummy load, perform the following steps:

1. Press red button in center of valve on cover

of transit case to equalize internal and external pressure.

2. Release four latches and lift cover from transit case.

3. Remove dummy load from transit case and position it on hex coupling nut (3MP6, fig. 3-3) on top of amplifier.

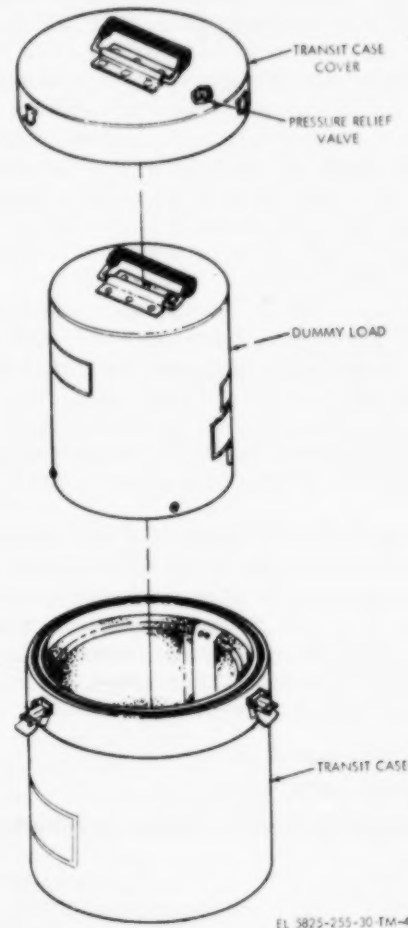


Figure 3-3. Dummy Load DA-640/TRN-30(V).

4. Connect ground strap provided with dummy load (not shown in figure 3-3) between ground connector at lower edge of dummy load and a ground point on base of amplifier.

(b) To remove and store the dummy load, perform the following steps:

1. Disconnect ground strap between dummy load and amplifier.

2. Carefully lift dummy load from amplifier hex coupling nut. It may be necessary to work the

dummy load side to side as it is lifted from the amplifier.

3. Replace dummy load in transit case, being careful to align ground connector at lower edge of dummy load with channel in foam cushion.

Section II. TROUBLESHOOTING

3-4. General

The direct support troubleshooting procedures in this section supplement the organizational maintenance procedures in TM 11-5825-255-12. Systematic troubleshooting begins with the sectionalization checks at the organizational level where a fault is traced to a major unit of the radio beacon set: transmitter, amplifier, antenna, battery, or external power source. Troubleshooting at the direct support level uses test and troubleshooting procedures to localize and isolate a fault to a subassembly, circuit card, or a specific component.

a. *Sectionalization.* The operational tests and associated preventive maintenance tables in TM 11-5825-255-12 provide tests for sectionalizing a fault to a major unit of the radio beacon set.

b. *Localization.* After the trouble has been sectionalized, a fault is then localized through visual inspection, continuity checks, or the electrical tests in section V.

c. *Isolation.* The isolation of a fault in the radio beacon set or maintenance kit cables consists of tracing the trouble to a faulty connector or a broken wire. Isolation of a fault in the transmitter or antenna consists of checking input and output voltages and waveforms, and isolating the problem to a subassembly, circuit card, or specific component.

3-5. Cable Troubleshooting

(fig. 3-4 and 3-5)

Troubleshooting the radio beacon set cables consists

4. Coil ground strap and place it into transit case.

5. Position transit case cover and secure with four latches.

of performing a visual inspection and continuity check at the organizational maintenance category, and repairing the cable at direct support maintenance category. Troubleshooting the maintenance kit cables consists of performing a visual inspection and continuity check, and repairing the cable at direct support maintenance.

a. *Visual Inspection.* Visually inspect the cables for broken connectors, pins, frayed wiring, or worn insulation. Repair cables as necessary.

b. *Continuity Checks.* Check continuity of radio beacon set cables using figure 3-4. Check continuity of maintenance kit cables using figure 3-5. The continuity reading shall be 2 ohms or less at each check. Repair cables as necessary.

3-6. Transmitter Troubleshooting Tests

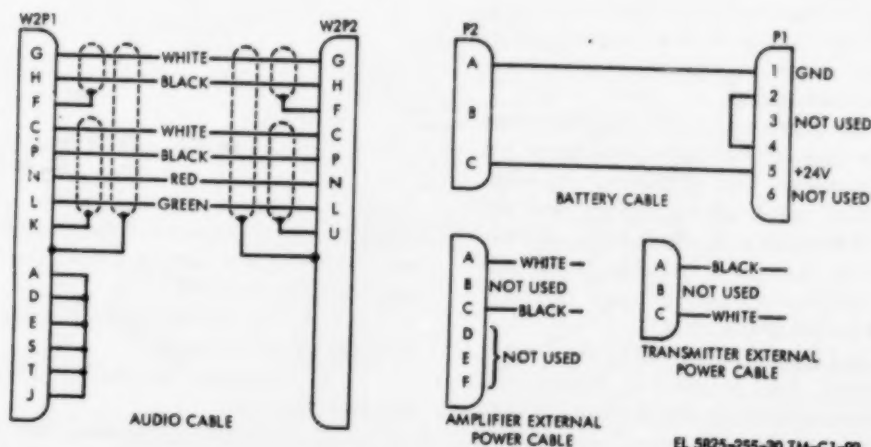
Use the test setup described in paragraph 3-7 and perform all the steps in paragraph 3-8. If abnormal indications are observed, refer to the transmitter troubleshooting chart (para 3-9).

3-7. Transmitter Troubleshooting Tests Setup (fig. 3-6)

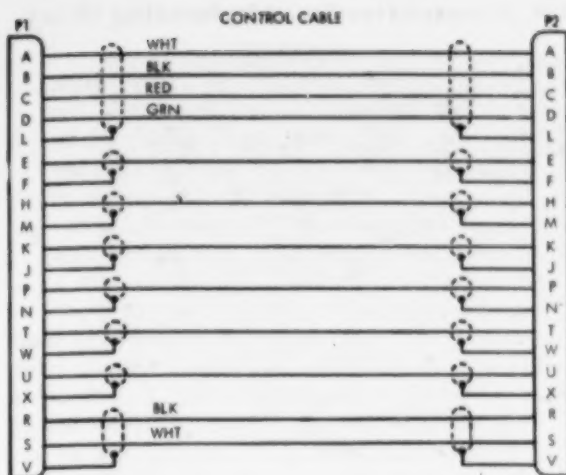
Connect the equipment for bench testing as shown in figure 3-6 and perform the following steps:

a. Connect power cable from $+28 \pm 0.5$ -vdc, 5-ampere power supply to input power connector 1J3 at rear of transmitter.

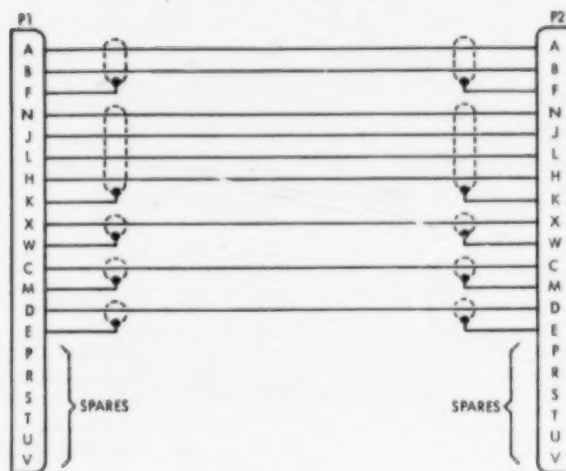
b. Insert Dummy Load DA-639/TRN-30(V) into connector 1J4 on transmitter and attach ground wire



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SWITCHED FILTER EXTENSION CONTROL CABLE



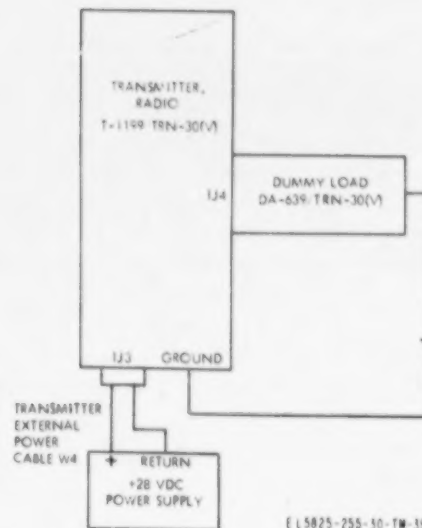
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Figure 3-5. Maintenance Kit, Electronic Equipment MK-1805/TRN-30(V) Cables, Schematic Diagram.

from dummy load to a convenient ground point on transmitter.

c. Set transmitter controls as follows:

PWR switch	OFF
FREQUENCY KHZ selection switches	Between 200 and 535.5 kHz
CODE switches	As desired
MODE selection switch	CW
CODE RATE control	As desired
ANT 15 FT-30 FT switch	30 FT



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Figure 3-6. Transmitter, Troubleshooting Test Setup.

d. Turn on power supply and adjust for $+28 \pm 0.5$ vdc.

3-8. Transmitter Troubleshooting Test Procedures

Refer to paragraph 3-7 and figure 3-6 for the test setup. In the following procedures, obtaining a correct indication in a particular step depends on satisfactory completion of all preceding steps. If abnormal indications are obtained, refer to the transmitter troubleshooting chart (para 3-9).

a. **VOLTAGE Meter Test.**

- (1) Set PWR switch at rear of transmitter to ON.
- (2) Observe that VOLTAGE meter needle is in green zone.

b. **RF Meter Test.**

- (1) Set PWR switch to OFF.
- (2) Set FREQUENCY KHZ switches for a frequency between 200 and 535.5 kHz.
- (3) Set ANT switch to 30 FT.
- (4) Set PWR switch to ON.
- (5) Listen and note that antenna coupler tuning motor operates and drives from medium to creep speed.
- (6) Observe that RF meter needle is in green zone.
- (7) Set PWR switch on transmitter to OFF.
- (8) Set ANT switch to 15 FT.
- (9) Set FREQUENCY KHZ switches for a frequency between 1605 and 1750 kHz.
- (10) Set PWR switch on transmitter to ON.
- (11) Listen and note that antenna coupler tuning motor operates and drives from medium to creep

speed.

(12) Observe that RF meter needle is in green zone.

c. *CODE Switch Test.*

- (1) Set CODE switches to ANAN.
- (2) Set MODE switch to MCW.
- (3) Observe short deflections of RF meter needle.
- (4) Set CODE switches to BDBD.
- (5) Observe that meter needle deflections change.

d. *CODE RATE Control Test.*

- (1) Set CODE RATE control for 7 WPM.
- (2) Observe meter needle deflections.
- (3) Change CODE RATE control setting to 20 WPM.
- (4) Observe increased speed of RF meter needle deflections.

e. *MODE Switch Test.*

- (1) Set and hold MODE switch to KEY.
- (2) Observe that RF meter indicates higher power output and release MODE switch.

f. *Simulated Tactical and Semifixed Mode Tests.*
Perform the tests in paragraph 3-29 and observe the following:

- (1) Word rate spacing.
- (2) Audio output.
- (3) Logic output.
- (4) Rf output.
- (5) Frequency accuracy.

b. *Transmitter Troubleshooting Chart.*

Item No	Symptom	Probable trouble	Checks and corrective action
1	PWR switch 1CB1 trips.	a. Input voltage greater than +40 vdc. b. Zener diode 1VR1 defective. c. Servo logic plug-in circuit card 1A11 defective. d. Short in +28 vdc circuit. e. Servoamplifier 1A3A4A1 defective. f. Switched filter 1A3A3 defective.	a. Check input voltage for $+28 \pm 0.5$ vdc, reduce if necessary. b. Check pin 2 of 1VR1 to ground for short. If 1VR1 is shorted, replace 1VR1. c. On 1A11, check for $+12 \pm 1$ vdc at TP1. If voltage is abnormal, replace 1A11. d. Make continuity check of +28 vdc circuits. If a short is indicated, remove and repair. e. Disconnect plug 1P5. Measure resistance from pin M on connector 1A3A4A1J1 to ground. If resistance is less than 100K ohms, perform servoamplifier 1A3A4A1 troubleshooting (fig. 3-9). f. Disconnect plug 1P3. Turn power ON. If transmitter operates, check K⁺ CR1, K2, and CR2 of 1A3A3 for shorted condition. Replace faulty component as necessary.
2	VOLTAGE meter M1 meter needle not in green zone	a. Same as Item 1. b. Low input voltage. c. Input line filter 1FL1 defective.	a. Same as item 1. b. Check input voltage for $+28 \pm 0.5$ vdc, increase input voltage if necessary. c. Check 1FL1 with an ohmmeter. The reading between terminals 1 and 3

3-9. Transmitter Troubleshooting Chart

WARNING

The transmitter contains high voltages which can cause DEATH or injury if contacted. The RF meter on the front panel should not be relied upon to ensure that high voltages are not present. Make sure that all power is turned OFF before any disassembly of the transmitter is performed. In addition, high voltage circuits should be grounded with a grounding probe to discharge capacitors.

a. *General.* The transmitter troubleshooting chart indicates operational trouble symptoms, probable troubles, checks, and corrective actions that should be taken to locate and remedy the trouble. Depending on the nature of the operational trouble symptom and probably troubles, one or more localizing and isolating procedures may be required. When isolating a trouble in a particular circuit, it may be necessary to remove various components to gain access to test points. Refer to paragraph 3-20 for component removal and replacement procedures. Schematic diagrams, parts location illustrations (fig. 3-7 and 3-8), and the exploded view (fig. 3-21) should be used with the troubleshooting chart. Although the interconnecting wiring (fig. FO-2 and FO-3) is usually not listed as a probable trouble in the troubleshooting charts, the interconnecting wiring should always be checked for continuity before a component or assembly is replaced.

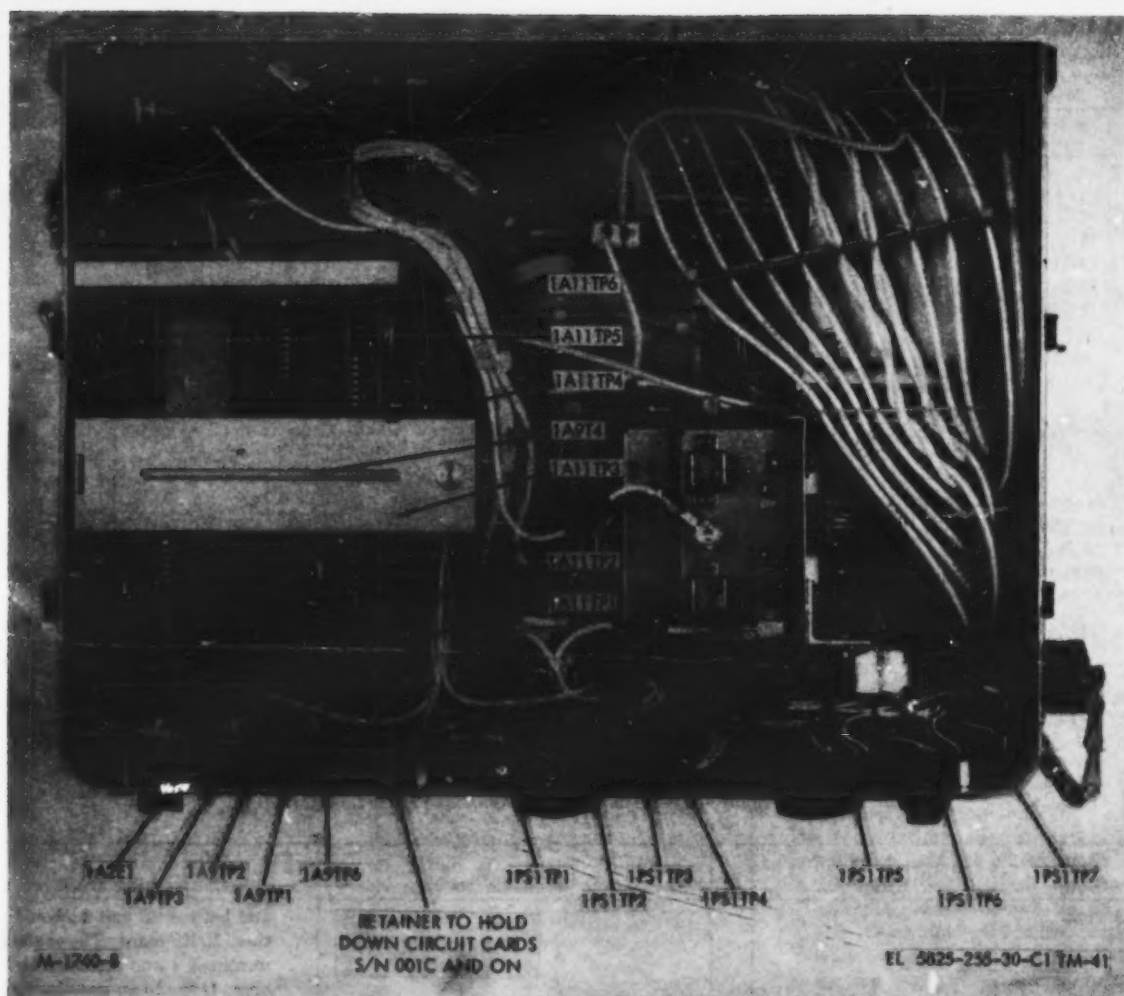


Figure 3-7. Transmitter, Parts Location.

Item No.	Symptom	Probable trouble	Checks and corrective action																								
2-cont		f. Transistor 1Q2 defective.	f. Disconnect plug 1P4. Use procedure in step e to check 1Q2.																								
			<table><tr><th colspan="2">Ohmmeter lead</th><th>Reading in ohms</th></tr><tr><th>OHMS -DC $\pm$ AC (± 1.5 vdc)</th><th>OHMS (COMMON)</th><td></td></tr><tr><td>F</td><td>D</td><td><1,000</td></tr><tr><td>D</td><td>F</td><td>>20,000</td></tr><tr><td>A</td><td>D</td><td><1,000</td></tr><tr><td>D</td><td>A</td><td>>20,000</td></tr><tr><td>F</td><td>A</td><td>>20,000</td></tr><tr><td>A</td><td>F</td><td>>20,000</td></tr></table> >= greater than <= less than	Ohmmeter lead		Reading in ohms	OHMS -DC $\pm$ AC (± 1.5 vdc)	OHMS (COMMON)		F	D	<1,000	D	F	>20,000	A	D	<1,000	D	A	>20,000	F	A	>20,000	A	F	>20,000
Ohmmeter lead		Reading in ohms																									
OHMS -DC $\pm$ AC (± 1.5 vdc)	OHMS (COMMON)																										
F	D	<1,000																									
D	F	>20,000																									
A	D	<1,000																									
D	A	>20,000																									
F	A	>20,000																									
A	F	>20,000																									
		g. Meter circuit defective.	g. Make continuity check of meter circuit.																								
		h. Meter M1 defective.	h. Replace meter M1.																								
3	Motor drive not running. Transmitter does not tune.	a. Power supply 1PS1 defective.	a. On 1PS1, check for -8 ± 0.5 vdc at 1PS1TP1, $+20 \pm 1$ vdc at 1PS1TP2, and $+8 \pm 0.5$ vdc at 1PS1TP3. If voltages at 1PS1TP1 and 1PS1TP2 are abnormal, check transistor 1Q2 (item 2f). If 1Q2 is normal and voltage at 1PS1TP3 is abnormal, replace 1PS1.																								
		b. Servo logic plug-in circuit card 1A11 defective.	b. On 1A11, check for $+12 \pm 0.5$ vdc at 1A1TP1, -5 ± 0.5 vdc at 1A1TP2, and $+5 \pm 0.5$ vdc at 1A1TP6. Use 28 pin extender card to check for $+0.2 \pm 0.2$ vdc at pin T. If voltages are abnormal, replace 1A11.																								
		c. Servoamplifier 1A3A4A1 defective.	c. Use 28-pin extender card to check at pin W of 1A11 for $+3.75 \pm 1.25$ vdc with high voltage switch 1A3A4S2 not on correct tap to 1L1. Check for $+0.2 \pm 0.2$ vdc when switch 1A3A4S2 is on correct tap to 1L1. If voltages are abnormal, troubleshoot 1A3A4A1 (fig. 3-9).																								
		d. Motor 1A3A4B1 defective.	d. Tag and disconnect wires from B1. Use an ohmmeter to measure across terminals on 1A3B1 for 150 ± 25 ohms. If abnormal, replace motor drive assembly 1A3A4.																								
		e. Binding gears in antenna coupler 1A3.	e. Check for binding gears located in variometer 1A3A2, switched filter 1A3A3, and motor drive assemblies. If binding is indicated, repair faulty subassembly by replacing defective mechanical part.																								
4	Motor drive does not run at medium speed; the transmitter does not tune.	a. Power supply 1PS1 defective.	a. Same as in item 3a.																								
		b. Lockout logic plug-in circuit card 1A8 defective.	b. Operate transmitter at 200 kHz and make following voltage checks at AUDIO connector 1J2: $+3.75 \pm 1.25$ vdc at pin C of 1J2. Set frequency to 285 kHz and check for $+3.75 \pm 1.25$ vdc at pin P of 1J2. Set frequency for 325 kHz and check for $+3.75 \pm 1.25$ vdc at pin N of 1J2.																								

Item No.	Symptom	Probable trouble	Checks and corrective action
4-cont			b. continued Set frequency for 535 kHz and check for $+3.75 \pm 1.25$ vdc at pin L of 1A12. If any voltages are not obtained, replace circuit card. c. Use 28-pin extender card to check at pin T of 1A11 for $+0.2 \pm 0.2$ vdc, or for a pulse train with a pulse repetition rate of 50 to 200 Hz, and from 0 to $+3.75 \pm 1.25$ volts peak. Check at 1A11TP1 for $+12 \pm 0.5$ vdc, 1A11TP2 for -5 ± 0.5 vdc, and 1A11TP6 for $+5 \pm 0.5$ vdc. If any voltages are abnormal, replace 1A11. d. Check at TP3 on logic and servo-amplifier plug-in circuit card 1A11 for $+3.75 \pm 1.25$ vdc when high voltage switch is on any tap to 1L1. If voltages are abnormal, replace switch S1 of variometer 1A3A2.
5	Motor drive not running at creep speed; transmitter does not tune.	c. Servo logic plug-in circuit card 1A11 defective. d. Variometer 1A3A2 defective. e. Power supply 1PS1 defective. f. Servo logic plug-in circuit card 1A11 defective. g. Plug-in circuit cards 1A4 through 1A8 defective. h. rf amplifier board 1A2 defective. i. Switched filter 1A3A3 or detector 1A3A1 defective. j. Variometer 1A3A2 defective. k. Tapped inductor 1L1 defective. l. High voltage switch 1A3A4S2 defective. m. Detector 1A3A1 defective.	a. Same as item 3a. b. On 1A11, check for $+12 \pm 0.5$ vdc at 1A11TP1, -5 ± 0.5 vdc at 1A11TP2, and $+5 \pm 0.5$ vdc at 1A11TP6. Use 28-pin extender card to check for $+0.2 \pm 0.2$ vdc at pin b. If any voltages are abnormal, replace 1A11. c. On rf amplifier board 1A2, check for 0- to 3-volt minimum square wave, at the frequency selected, at 1A2E1. If voltage is abnormal, refer to item 10. d. Disconnect plug 1A2P2 and terminate with Dummy Load DA-75/U. Check for a 25 ± 5 volt peak-to-peak square wave across the load. If voltage is abnormal, replace 1A2. e. Disconnect 1A3A1 and use an ohmmeter to check for continuity from E1 to P1, and for $5 \text{ k}\Omega$ to $\text{k}\Omega$ resistance from E1 to ground. If abnormal, replace 1A3A1. If normal, replace 1A3A3. f. Check E3 of 1A3A2TB2 for a minimum 15-volt peak-to-peak sine wave with high voltage switch 1A3A4S2 on correct tap to 1L1. See figure 3-9 for location of 1A3A2TB2E3. If abnormal, replace variometer coils 1A3A2L1 through 1A3A2L4. g. Use an ohmmeter to check 1L1 for open windings. Replace if necessary. h. Check 1A3A4S2 for continuity with an ohmmeter. If abnormal, replace high voltage switch 1A3A4S2. i. Use dual trace scope. Monitor rf voltage at E3 of 1A3A2TB2 with one channel. With remaining channel,

ym No.	Symptom	Probable trouble	Checks and corrective action
cont			i.-continued monitor 1A11TP4. When rf voltage at E3 exceeds 15 volts peak-to-peak, voltage at 1A11TP4 should become $+3.75 \pm 1.25$ vdc. If abnormal, replace 1A3A1.
6	Transmitter tunes; RF meter needle not in green zone.	a. Servo logic plug-in circuit card 1A11 defective. b. Detector 1A3A1 defective. c. Servoamplifier 1A3A4A1 defective. d. Rf meter 1M2 circuit defective.	a. Use 28-pin extender card to check at pins T and L of 1A11 for $+3.75 \pm 1.25$ vdc. If abnormal, replace 1A11. b. Use 28-pin extender card to check at pin Z of 1A11 for $+0.2 \pm 0.2$ vdc while transmitter tunes at high speed. If abnormal, replace 1A3A1. c. Troubleshoot servoamplifier 1A3A4A1 (fig. 3-9). d. Replace 1M2. If trouble persists, replace 1A3A1.
7	Low, distorted, or no modulation.	a. TCXO and fixed divider plug-in circuit card 1A6 defective. b. Encoder No. 2 plug-in circuit card 1A9 defective. c. MODE switch 1S2 defective. d. Power supply 1PS1 defective.	a. On 1A6, check for a 3.000 MHz ± 3Hz, 0 to 3.75 ± 1.25 volt square wave at 1A6TP1. If abnormal, replace 1A6. b. Set MODE switch to CW. Use 17-pin extender card to check for 0 to $+3.75 \pm 1.25$ volt 1020 Hz ± 10 Hz square wave at pin G. If voltage is abnormal, replace 1A9. c. Set MODE switch to KEY. On 1PS1, check for a 0 to 1.0 ± 0.5 volt peak 1020 Hz ± 10 Hz square wave at 1PS1TP6. If abnormal, replace defective MODE switch 1S2. d. On 1PS1, check at 1PS1TP5 for a $+0.5 \pm 0.5$ volt to a $+19.5 \pm 0.5$ volt peak-to-peak 1020 Hz ± 10 Hz sine wave. If voltage is abnormal, replace 1PS1.
8	Incorrect or no coded modulation.	e. rf amplifier board 1A2 defective. a. Encoder No. 2 plug-in circuit card 1A9 defective. b. Encoder No. 1 plug-in circuit card 1A10 defective. c. MODE switch 1S2 defective.	e. If trouble persists, replace 1A2. a. On 1A9, check 1A9TP3 for $+0.2 \pm 0.2$ vdc for 3.5 ± 1 sec followed by $+3.75 \pm 1.25$ vdc lasting for a time determined by the code rate and letters. Check 1A9TP2 for $+0.2 \pm 0.2$ vdc for 3.5 ± 1 sec followed by $+3.75 \pm 1.25$ vdc lasting for a time determined by the code rate and letters. If abnormal, replace 1A9. b. Set CODE switches to JJJJ. Adjust CODE RATE control to 7 WPM. Set MODE switch to MCW. Turn transmitter ON. On CODE switches 1S8 through 1S11, check at pin C of each switch for $+3.75 \pm 1.25$ vdc for 4 ± 1 seconds, followed by 0.2 ± 0.2 vdc for 16 ± 1 seconds. Pin C for switch 1S11 is shown in figure 3-7. If voltages are abnormal, replace 1A10. If voltages are normal, replace defective CODE switches 1S8 through 1S11. c. Check for continuity between pins 2 and 3 of 1S2. If abnormal, replace 1S2.

Item No.	Symptom	Probable trouble	Checks and corrective action
9	Incorrect word rate spacing.	a. Encoder No. 2 plug-in circuit card 1A9 defective. b. CODE RATE control 1R1 or wiring defective.	a. Replace by substitution. If trouble persists, check CODE RATE control 1R1. b. Remove circuit card 1A9 and replace with 17 pin extender card. Measure resistance between pins H and F of extender card as CODE RATE control is moved from 7 WPM to 20 WPM. Resistance should be a maximum of 100 k-ohms +10% and a minimum of less than 10 ohms. If resistance is abnormal, repair wiring or replace CODE RATE control 1R1.
10	Wrong frequency output.	a. Fixed divider plug-in circuit card 1A6 defective. b. Fixed divider plug-in circuit card 1A6 defective. c. Lockout logic plug-in circuit card 1A8 defective. d. VCO plug-in circuit card 1A4 defective. e. Control divider plug-in circuit card 1A7 defective. f. Phase detector plug-in circuit card 1A5 defective.	a. On 1A6, measure with a frequency counter at 1A6TP1 for 3 MHz $\pm$ 3 Hz. Also at 1A6TP1, check for a +0.2 $\pm$ 0.2 vdc to +3.75 $\pm$ 1.75 vdc square wave. If frequency is abnormal, refer to paragraph 3-19 for TCXO adjustment. If voltage is abnormal, replace 1A6. b. Use 17-pin extender card to check pin F for 500 $\pm$ 6 Hz and for a +0.2 $\pm$ 0.2 vdc to +3.75 $\pm$ 1.75 vdc square wave. If signal or voltage is abnormal, replace 1A6. c. Use 34-pin extender card to check at pin E on 1A8 for +0.2 $\pm$ 0.2 vdc. If voltage is abnormal, replace 1A8. d. Use 28-pin extender card to check circuit card 1A4 for -5 $\pm$ 0.5 vdc at pin E, +15 $\pm$ 0.5 vdc at pin F, and 0 to +3.75 $\pm$ 1.25 vdc square wave at pin w at a frequency of approximately 200 kHz to 1 MHz. If voltages are abnormal, replace 1A4. e. Use 28-pin extender card to check 1A7 at pin H for a +3.75 $\pm$ 1.25 vdc pulse which drops to +0.2 $\pm$ 0.2 vdc for 1 to 5 microseconds. The spacing between pulses is 2 milliseconds. If abnormal, replace 1A7. f. Use 17-pin extender card to check 1A5 for +5 to +10 vdc at pin P. If voltage is abnormal, replace 1A5.

NOTE

Items 11 through 13 refer to troubles appearing when performing simulated tactical and semifixed mode testing on the transmitter.

11	Improper audio output.	a. Same as item 7a through d.	a. Same as item 7a through d.
12	Improper logic output.	a. Same as item 4b. b. Defective FREQUENCY KHZ switches 1S3 through 1S7.	a. Same as item 4b. b. Check continuity of switches. Replace defective switches.
13	No rf output.	a. Same as item 5a. b. Same as item 10. c. Same as item 5c. d. Relay 1A3A3K1 defective.	a. Same as item 5a. b. Same as item 10. c. Same as item 5c. d. Disconnect plug 1A2P2. Ground pin J of audio connector 1J2. Turn power on and measure continuity from J1 of 1A3A3 to W1J1. If no continuity, replace relay 1A3A3K1.

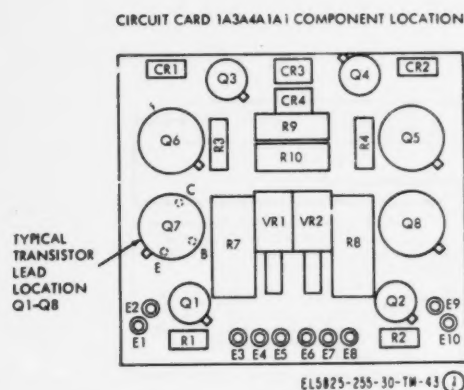


Figure 3-9. Servoamplifier 1A3A4A1, Troubleshooting Flow Diagram (Sheet 1 of 3).

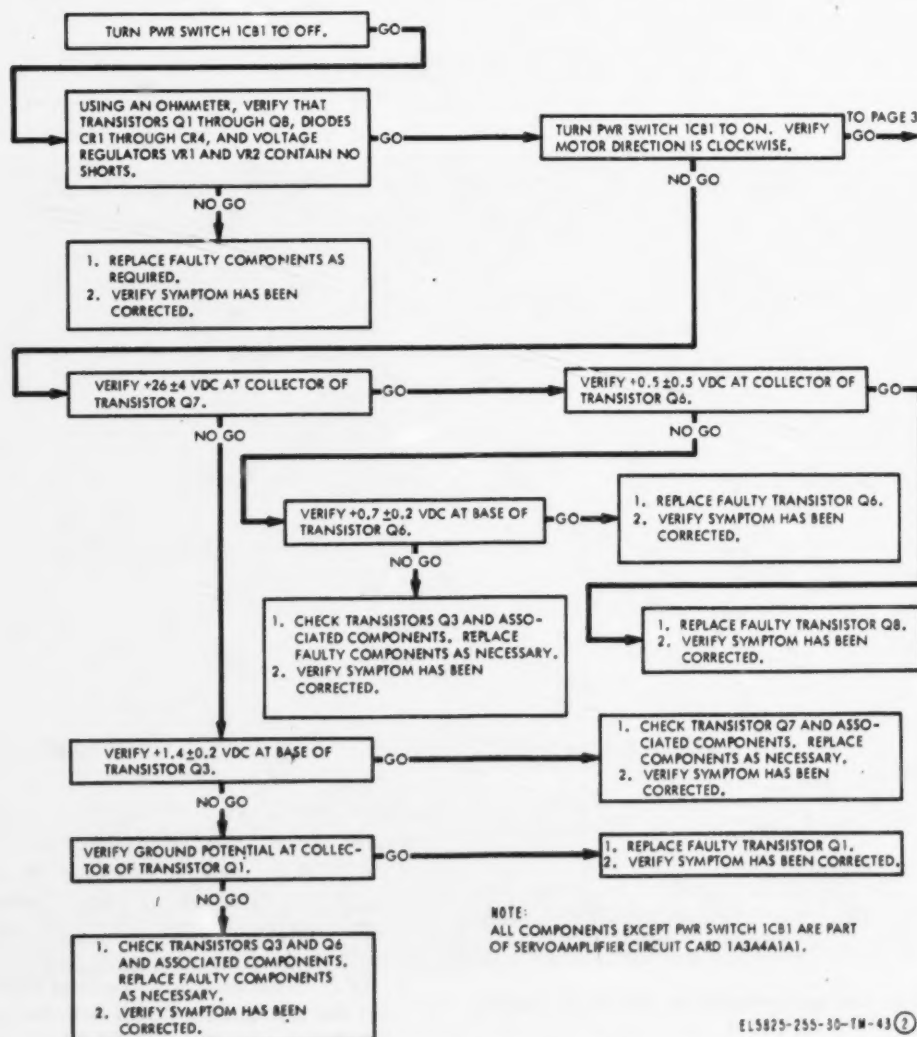


Figure 3-9. Servoamplifier 1A3A4A1, Troubleshooting Flow Diagram (Sheet 2 of 3).

3-10. Amplifier Troubleshooting Tests

Use the test setup in paragraph 3-11 and perform all the steps in paragraph 3-12. If abnormal indications are observed, refer to the amplifier troubleshooting chart (para 3-13).

3-11. Amplifier Troubleshooting Test Setup

Connect the equipment for bench testing as shown in figure 3-10 and perform the following steps:

- Set amplifier POWER switch and transmitter PWR switch to OFF.
- Set amplifier PUSH TO TURN switch to TACTICAL.
- Set $+28 \pm 0.5$ vdc, 30 ampere power supply to off.
- Place Dummy Load DA-640/TRN-30(V) on

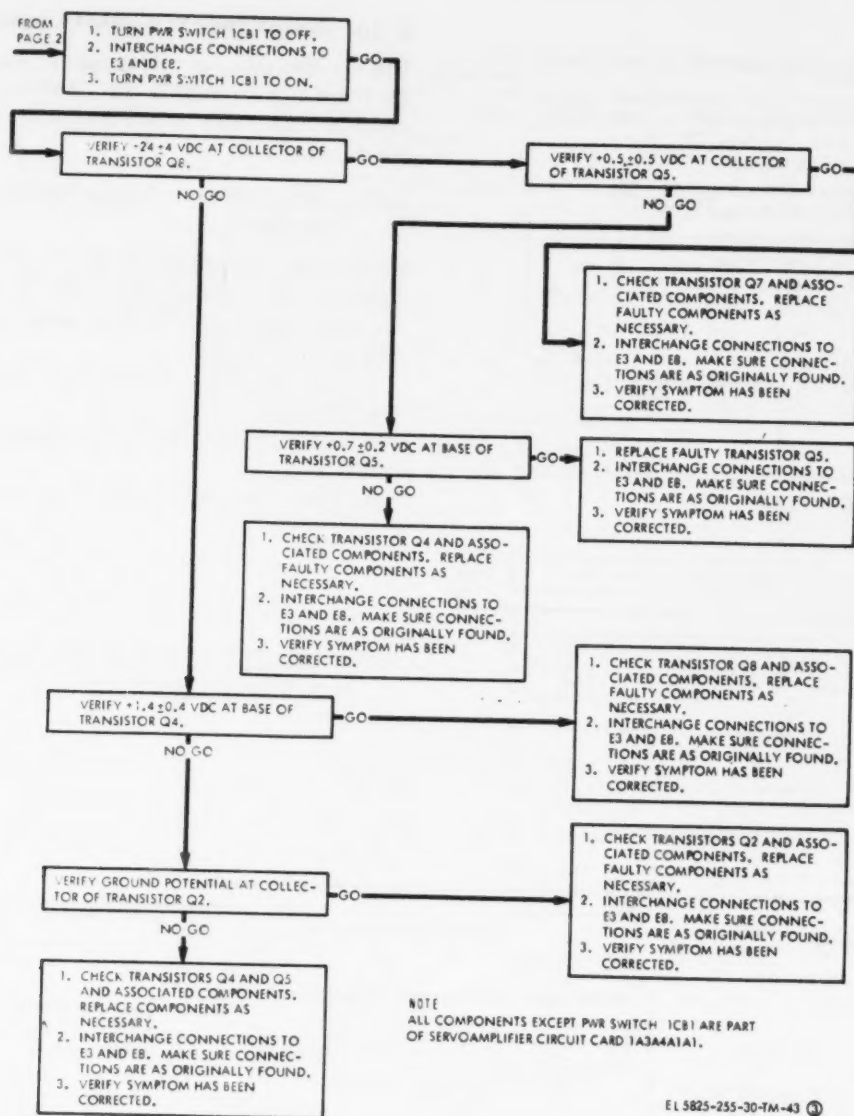


Figure 3-9. Servoamplifier 1A34A1, Troubleshooting Flow Diagram (Sheet 3 of 3).

amplifier antenna connector and attach ground wire from dummy load to convenient ground.

e. Connect amplifier external power cable from amplifier EXT POWER connector 3J1 to power supply. Observe correct polarity at power supply.

f. Connect transmitter external power cable assembly from transmitter input power connector 1J3 to power supply. Observe correct polarity at power supply.

g. Connect rf and audio cables as shown in figure 3-10.

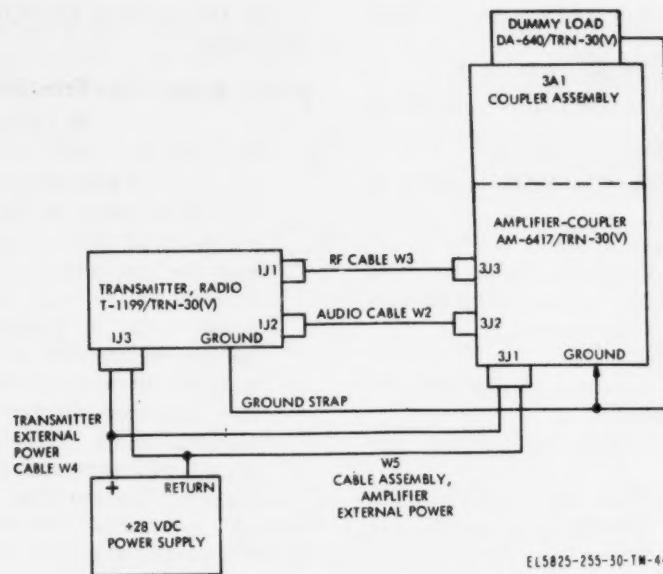
h. Connect a ground strap between all equipment.

3-12. Amplifier Troubleshooting Test Procedures

Refer to paragraph 3-11 and figure 3-9 for the test setup. In the following procedures obtaining a correct indication in a particular step depends on satisfactory completion of all preceding steps. If abnormal indications are obtained, refer to the amplifier troubleshooting chart (para 3-13).

a. RF POWER Meter and Tactical Mode Tests.

- (1) Set transmitter CODE switches to ANAN.
- (2) Set transmitter FREQUENCY KHZ switches to 200 kHz.



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Figure 3-10. Amplifier, Troubleshooting Test Setup.



Figure 3-11. Amplifier, Parts Locations (Right Side View).

- (3) Set transmitter CODE RATE control to mid-range.
- (4) Set transmitter MODE switch to MCW.
- (5) Turn on +28 vdc power supply and adjust for $+28 \pm 0.5$ vdc if necessary.
- (6) Set transmitter PWR switch to ON.
- (7) Set amplifier PUSH TO TURN switch to TACTICAL I.
- (8) Set POWER switch on amplifier to ON.
- (9) Allow 15 seconds for tuning. Listen and note that antenna coupler drives at high speed and then reduces to medium and then to creep speed.

NOTE

Record power supply current in all positions of PUSH TO TURN switch.

- (10) Observe that rf POWER meter needle is in green zone.
 - (11) Set PUSH TO TURN switch to TACTICAL 2.
 - (12) Observe that RF POWER meter needle is in green zone.
 - (13) Set PUSH TO TURN switch to TACTICAL 3.
 - (14) Observe that rf POWER meter needle is in green zone.
- b. Semifixed Mode Test.*
- (1) Set PUSH TO TURN switch to SEMIFIXED.

- (2) Observe that RF POWER meter needle is in green zone.

3-13. Amplifier Troubleshooting Chart

WARNING

The amplifier contains high voltages which can cause DEATH or injury if contacted. The rf POWER meter on the front panel should not be relied upon to ensure that high voltages are not present. Make sure that the POWER switch is set to OFF and that the power cable is disconnected before any further disassembly of the amplifier is attempted. In addition, dangerous potentials may exist from charged capacitors. To avoid electrical shock, discharge the high voltage circuits with a grounding probe.

a. General. The amplifier troubleshooting chart indicates operational trouble symptoms, probable troubles, checks, and corrective actions that should be taken to locate and remedy the trouble. Depending on the nature of the operational symptom and probable troubles, one or more localizing and isolating procedures may be required. When isolating a trouble to a particular circuit, it may be necessary to remove var



Figure 3-12. Amplifier, Parts Locations (Rear View).

ious components to gain access to test points. Refer to paragraph 3-23 for removal and replacement procedures. Schematic diagrams, part location illustrations (fig. 3-11, through 3-14), and the exploded view (fig. 3-23) should be used with the troubleshooting

chart. Although the interconnecting wiring (fig. FO-28) is usually not listed as a probable trouble in the troubleshooting charts, the interconnecting wiring should always be checked for continuity before a component or assembly is replaced.

Amplifier Troubleshooting Chart.

No.	Symptom	Probable trouble	Checks and corrective action
1	POWER switch 3FL1CB1 trips.	a. Short in +28 vdc circuit. b. Zener diode 3FL1VR1 shorted.	a. Perform continuity check of +28 vdc circuit. If a short is indicated, remove short and repair as necessary. b. Check 3FL1VR1 with an ohmmeter. Verify 3FL1VR1 is not shorted in both directions. If a short is indicated, replace input line filter 3FL1.
2	In TACTICAL 1, 2, or 3 position, the RF POWER meter 3M1 needle is not in green zone and amplifier does not tune.	CAUTION At any time the input power supply current exceeds 5 amperes, turn the equipment power OFF and proceed to item 3. a. Same as item 1. b. POWER switch 3FL1CB1 defective. c. Power supply 3PS1 defective.	a. Same as item 1. b. Disconnect power cable and set circuit breaker 3FL1CB1 to ON. Use an ohmmeter to check continuity across 3FL1CB1. If an open is indicated, replace 3FL1. c. Remove power amplifier-power supply 3A4 (leave cables attached). On 3PS1, check for -8 ± 0.3 vdc at 3PS1TP1 and -8 ± 0.3 vdc at



Figure 3-13. Amplifier, Parts Locations (Left Side View).

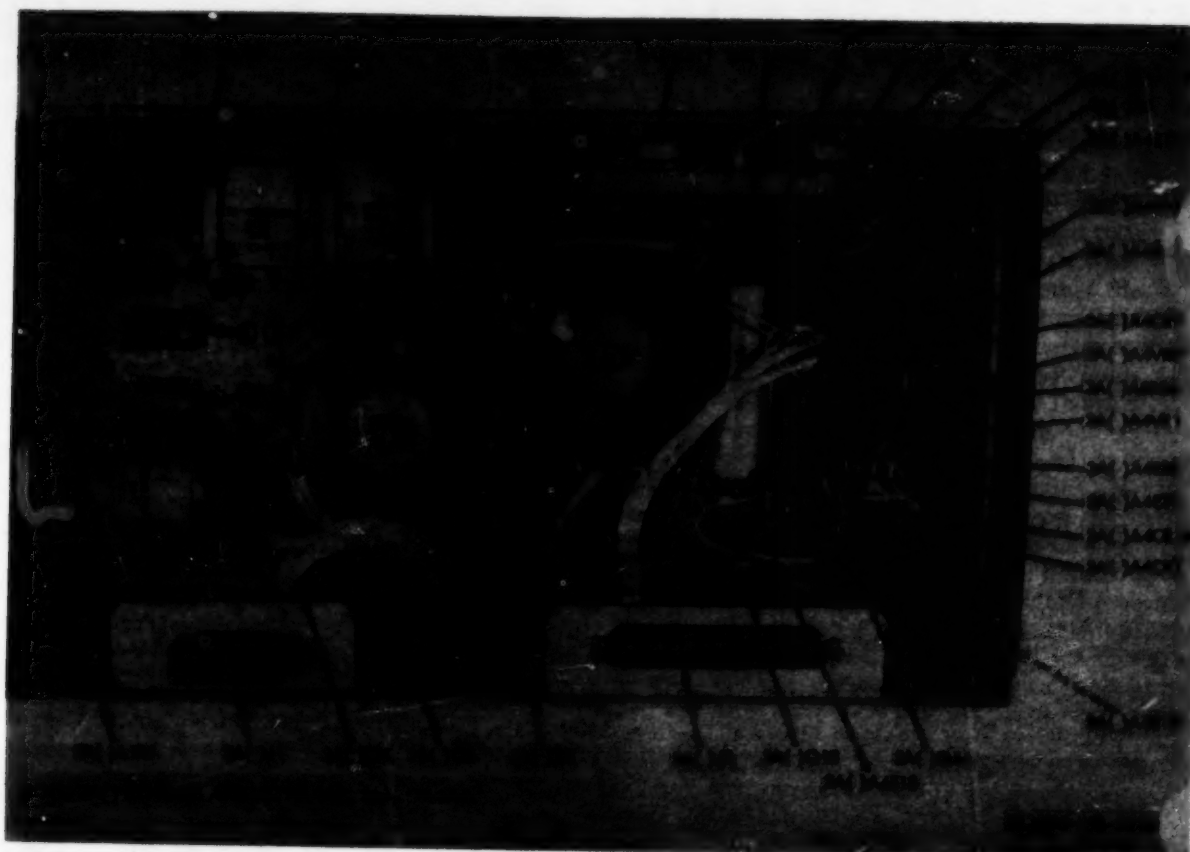


Figure 3-14. Power Amplifier-Power Supply 3A(), Parts Locations.

Item No	Symptom	Probable trouble	Checks and corrective action
2-cont			c.-continued 3PS1TP2. If voltages are abnormal, troubleshoot 3PS1 (e below). If voltages are normal, proceed to step d.
		d. Logic and servoamplifier board 3A1A2 defective.	d. Perform continuity check of wire harness from logic and servoamplifier 3A1A2. If normal, replace logic and servoamplifier 3A1S2.
		e. Power amplifier-power supply 3A2, 3A3, or 3A4 defective.	e. Replace applicable assembly. If symptom is corrected, troubleshoot defective power amplifier-power supply (c below). If symptom persists, reinstall removed assembly and proceed to item 3.
		f. Antenna coupler 3A1 defective.	f. Refer to antenna coupler troubleshooting chart (d below).
		g. rf POWER meter circuit defective.	g. Perform continuity check of amplifier cable harness to rf POWER meter 3M1. If normal, replace rf POWER meter 3M1.
3	In TACTICAL 1, 2, or 3 position, input power supply current to amplifier is 5 amperes or greater.	a. Power amplifier-power supply 3A2, 3A3, or 3A4 defective.	a. Replace applicable assembly. If symptom is corrected, troubleshoot defective power amplifier-power supply

Item No.	Symptom	Probable trouble	Checks and corrective action
3-cont			a. continued ply (c below). If symptom persists, reinstall removed assembly and proceed to step b. b. Refer to switched filter performance test (para 3-14). If normal, replace power and phase detector 3A1A3. a. Same as item 3. b. Allow amplifier 15 seconds to tune. Then turn PWR switch on transmitter to OFF. Observe a momentary drop of the current meter on the input dc power supply to the amplifier. Turn the transmitter power ON. Observe another movement on current meter. If no fluctuations are observed, troubleshoot defective power amplifier-power supply (c below). c. Perform continuity check of wire harness from logic and servoamplifier 3A1A2. If normal, replace logic and servoamplifier 3A1A2. d. Perform continuity check of wire harness from power and phase detector. If normal, replace power and phase detector board 3A1A3. e. Refer to ± 8 vdc power supply troubleshooting chart (e below). f. Refer to antenna coupler troubleshooting chart (d below).
4	In TACTICAL 1, 2, or 3 position, RF POWER meter 3M1 needle is not in green zone and antenna tuning motor is running from end to end.	b. Switched filter 3A5 has selected the wrong filter. a. Same as item 3. b. Power amplifier-power supply 3A2, 3A3, or 3A4 defective. c. Logic and servoamplifier 3A1A2 defective. d. Power and phase detector board 3A1A3 defective. e. ± 8 vdc power supply 3PS1 defective. f. Antenna coupler 3A1 defective.	a. Perform continuity check of wire harness from logic and servoamplifier. If normal, replace logic and servoamplifier board 3A1A2. a. Perform continuity check of wire harness from servoamplifier logic. If normal, replace logic and servoamplifier board 3A1A2. b. Perform continuity check of wire harness from power and phase detector. If normal, replace power and phase detector board 3A1A3. c. Refer to antenna coupler troubleshooting chart (d below).
5	In TACTICAL 1, 2, or 3 position, RF POWER meter 3M1 needle does not indicate in green zone and antenna tuning motor does not run at creep speed.	a. Logic and servoamplifier circuit defective.	a. Perform continuity check of wire harness from logic and servoamplifier. If normal, replace logic and servoamplifier board 3A1A2.
6	In TACTICAL 1, 2, or 3 position, RF POWER meter 3M1 needle does not indicate in green zone and antenna tuning motor does not run at creep speed.	a. Logic and servoamplifier circuit defective. b. Power and phase detector circuit defective. c. Antenna coupler motor drive circuit defective.	a. Perform continuity check of wire harness from power and phase detector. If normal, replace power and phase detector board 3A1A3. c. Refer to antenna coupler troubleshooting chart (d below).
7	In TACTICAL 1, 2, or 3 position, amplifier is tuned but no modulation is indicated on rf POWER meter.	a. Power amplifier-power supply 3A2, 3A3, or 3A4 defective. b. Logic and servoamplifier circuit defective.	a. Refer to power amplifier-power supply troubleshooting chart (c below). b. Perform continuity check of wire harness from logic and servoamplifier. If normal, replace logic and servoamplifier board 3A1A2.
8	In TACTICAL 1, 2, or 3 position, amplifier is tuned but no modulation is indicated on rf POWER meter. (Modulation is indicated by swing of meter needle).	a. Power amplifier-supply 3A2, 3A3, or 3A4 defective. b. Logic and servoamplifier board 3A1A2 defective.	a. Perform modulation adjustment (para 3-16). If trouble persists, troubleshoot defective power amplifier-power supply (c below). b. Same as item 7b.
9	Amplifier is tuned; modulation is low in SEMIFIXED position.	Power amplifier-power supply 3A2, 3A3, or 3A4 defective. NOTE The () symbol following reference designation 3A indicates one of the three power amplifier-power supplies, 3A2, 3A3, or 3A4.	Set PUSH TO TURN switch to each TACTICAL position. If modulation is low in any position, perform modulation adjustment procedure (para 3-17). If trouble persists, troubleshoot defective power amplifier-power supply (c below).

Item No	Symptom	Probable trouble	Checks and corrective action
10	Modulation is low in all three TACTICAL positions.	Audio transformer 3JB1T1 defective.	Remove power amplifier-power supply 3A2 from amplifier housing (para 3-23(1) and (2)). Do not disconnect plugs. Remove cover plate 3A2MP3. Connect oscilloscope to pin E11 on power amplifier interconnect board 3A2A4. Push transmitter MODE switch to KEY and observe a 1.6 ± 0.16 volt peak-to-peak sine wave. If voltage is not present, replace audio transformer 3JB1T1.

c. *Power Amplifier-Power Supply Troubleshooting Chart.* If defective power supply was disconnected during troubleshooting of the amplifier, reconnect the power amplifier-power supply to the amplifier. Place PUSH TO TURN switch in TACTICAL 1, TACTICAL 2, or TACTICAL 3 for defective 3A2, 3A3, or 3A4, re-

spectively.

NOTE

The () symbol following reference designation 3A indicates one of the three power amplifier-power supplies 3A2, 3A3, or 3A4.

Item No	Symptom	Probable trouble	Checks and corrective action
1	RF POWER meter does not indicate in green zone and amplifier does not tune.	a. +22 vdc power supply defective. b. ± 8 vdc power supply 3PS1 defective. c. Power amplifier modulator board 3A()A5 defective. d. Power amplifier driver transistor Q13 or Q14, or transformer T3 defective. e. Power amplifier interconnect board 3A()A4 defective.	a. Measure at 3A()A2E6 for +22 vdc. If voltage is abnormal, proceed to item 2. If voltage is normal, proceed to item 1b. b. Measure at 3PS1TP2 for +8 vdc. If voltage is abnormal, refer to ± 8 vdc power supply troubleshooting chart (e below). c. Set amplifier to operate at 200 kHz in appropriate TACTICAL mode. Use oscilloscope to measure at pins E21 and E22 on 3A()A4 board for a waveform as shown in A, figure 3-15. If waveform is not as indicated, check at pin E13 on 3A()A4 board for waveform as shown in B, figure 3-15. If voltage is present, replace 3A()A5. If voltage is not present, check connector 3A()J2. d. Use oscilloscope to check at pins E18 and E19 on 3A()A4 board for waveform as shown in C, figure 3-15. If voltage is abnormal, replace transistor 3A()Q13 or 3A()Q14, or transformer 3A()T3, and check diodes CR7, CR9, CR16, and Zener diodes VR1 and VR2 on 3A()A4. e. Use ohmmeter to check components on board for open or shorted condition. If defect is noted, replace 3A()A4.
2	No +22 vdc at 3A()A2E6	a. Transistors 3A()Q4 and 3A()Q5 defective.	a. Check transistors 3A()Q4 and 3A()Q5. Replace if necessary. NOTE When either transistor is replaced, check to see that a short does not exist between 3A()A2E6 and ground, and that diode 3A()CR2 is not open in a forward direction.

Item No.	Symptom	Probable trouble	Checks and corrective action
2-cont			
3	rf POWER meter does not indicate modulation.	b. +22 vdc power supply board 3A()A1 defective. c. Power supply interconnect board 3A()A2 defective. a. Modulation disable signal incorrect. b. Power amplifier modulator board 3A()A5 defective.	b. Connect oscilloscope to top lead of resistor 3A()A1R5 and observe a $+28 \pm 2$ volt, $+1 \pm 1$ volt square wave. If voltage is abnormal, replace 3A()A1. c. Replace 3A()A2. a. Use voltmeter to check at pin E10 on 3A()A4 for a voltage less than +0.5 vdc when transmitter MODE switch is in KEY position. If voltage is abnormal, check 3A()J2. b. Use oscilloscope to measure at pins E7 and E8 on 3A()A4 board for waveform as shown in D, figure 3-15. If voltage at E10 (a, above) is correct and voltages at E7 and E8 are incorrect, replace 3A()A5. NOTE The erroneous waveform at E7 and E8 can also be caused by defective resistors 3A()A4R1 and 3A()A4R2 or transistors Q11 and Q12. Check the listed piece parts. Replace Q11, Q12, or 3A()A4 as necessary.

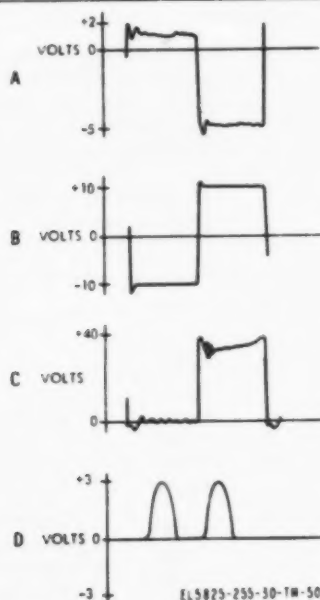


Figure 3-15. Power Amplifier-Power Supply Waveform.

d. Antenna Coupler 3A1 Troubleshooting Chart.

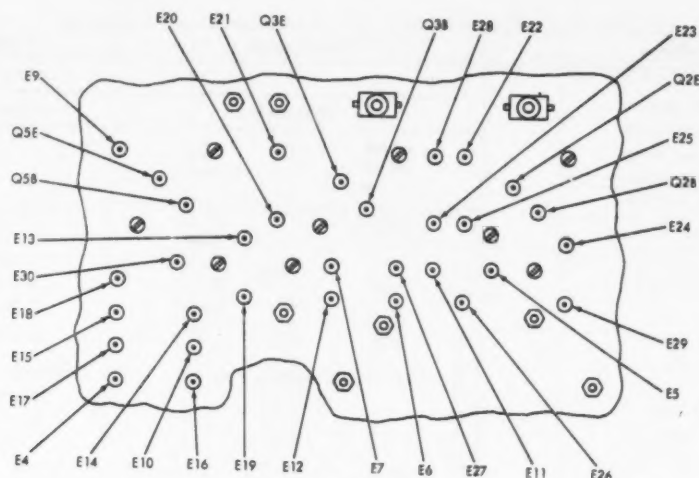
WARNING

20,000 volts is present at the top of tuning coil 3A1A4. Do not touch the tuning coil during the following troubleshooting chart steps if power is applied to the amplifier. Remove amplifier cover housing 3MP33 per paragraph 3-23a(1) and (2). Remove circuit cards 3A1A2 and 3A1A3 (para 3-23g and h) and disconnect 3W1P8. See figure 3-23, sheet 2 for component locations. See figure 3-16 for locations of test points.

Item No.	Symptom	Probable trouble	Checks and corrective action
1	Amplifier does not tune.	a. Antenna tuning mechanism does not turn freely. b. Regulator transistors 3A1A1Q5 and 3A1A1Q6 defective.	a. Check to see that tuning shaft turns freely by hand. If not, replace tuning coil assembly 3A1A4. b. With Multimeter TS-352B/U set on X100 multiplier scale, check transistors 3A1A1Q5 and 3A1A1Q6 by making the following measure-

Item No	Symptom	Probable trouble	Checks and corrective action	
1-cont			b. -continued ments. (Any equivalent 20,000 Ω/v multimeter set on the X100 multiplier scale with +1.5 vdc on the test leads as shown may be used for the test.)	
		Ohmmeter lead	Reading in ohms	Component
		OHMS -DC $\pm$ AC (+1.5 vdc)	OHMS (COMMON)	
		Q5E	Q5B	>20K
		Q5B	Q5E	<1K
		Q5B	E14	<1K
		E14	Q5B	>500
		Q5E	E14	>10K
		E14	Q5E	>1.6K
		E13	E30	>1K
		E30	E13	<1K
		E30	E14	<1K
		E14	E30	>400
		E13	E14	>400
		E14	E13	>500
				>= greater than <= less than
		c. End stop switches 3A1A1A2S1 or 3A1A1A2S2 open.	c. Check continuity between E22 and ground for 3A1A1A2S1, and between E21' and ground for 3A1A1A2S2. Replace open switch as necessary.	
		d. Motor drive transistors 3A1A1Q1 through 3A1A1Q4 defective.	d. Check transistors with Multimeter TS-352B/U as in step b. Replace defective transistors.	
		Ohmmeter lead	Reading in ohms	Component
		OHMS -DC $\pm$ AC (+1.5 vdc)	OHMS (COMMON)	
		E24	E5	>20K
		E5	E24	<1K
		E5	E29	<1.2K
		E29	E5	>20K
		E29	E24	>20K
		E24	E29	<1.5K
		Q2E	Q2B	>7K
		Q2B	Q2E	<1K
		Q2B	E25	<1K
		E25	Q2B	>20K
		E25	Q2E	>20K
		Q2E	E25	>420
		Q3E	Q3B	>20K
		Q3B	Q3E	<1K
		Q3B	E11	<1K
		E11	Q3B	>20K
		E11	Q3E	>20K
		Q3E	E11	>420
				(Unsolder wire connected to Q2B for test)
				3A1A1Q2
				(Unsolder wire connected to Q3B for test)
				3A1A1Q3

Item No.	Symptom	Probable trouble	Checks and corrective action		
1-cont			<i>d. -continued</i>		
		Ohmmeter lead	Reading in ohms	Component	
		OHMS - DC $\pm$ AC (+ 1.5 vdc)	OHMS (COMMON)		
		E20	E7	$\left. \begin{array}{l} > 20K \\ < 1.2K \\ < 1.2K \\ > 20K \\ > 20K \\ > 1.5K \end{array} \right\} 3A1A1Q4$	
		E7	E20		
		E7	E19		
		E19	E7		
		E19	E20		
		E20	E19		
		<i>e. Motor 3A1B1 winding open.</i>		<i>e. Remove three leads to motor and check motor continuity with ohmmeter. If abnormal, replace motor 3A1B1.</i>	
		<i>f. Diodes 3A1A1CR1 through 3A1A1CR4 defective.</i>		<i>f. Check diodes with Multimeter TS-352B/U as in step b. Tag and disconnect motor 3A1B1 leads from TB1 before testing diodes 3A1A1CR1 and 3A1A1CR2.</i>	
		Ohmmeter lead	Reading in ohms	Component	
		OHMS - DC $\pm$ AC (+ 1.5 vdc)	OHMS (COMMON)		
		E6	E12	$\left. \begin{array}{l} > 10K \\ < 1K \\ < 1K \\ > 10K \\ > 10K \\ < 1K \\ > 10K \\ < 1K \end{array} \right\} \begin{array}{l} 3A1A1CR1 \\ 3A1A1CR2 \\ 3A1A1CR3 \\ 3A1A1CR4 \end{array}$	
		E12	E6		
		E26	E6		
		E6	E26		
		E11	E5		
		E5	E11		
		E27	E7		
		E7	E27		
		<i>g. Zener diode 3A1A1VR1 or capacitor 3A1A1C2 defective.</i>		<i>g. Check diode and capacitor with Multimeter TS-352B/U as in step b. Replace defective components as necessary.</i>	
		Ohmmeter lead	Reading in ohms	Component	
		OHMS - DC $\pm$ AC (+ 1.5 vdc)	OHMS (COMMON)		
		E10	E17	$\left. \begin{array}{l} > 20K \\ < 1.2K \\ > 20K \end{array} \right\} \begin{array}{l} 3A1A1VR1 \\ 3A1A1C2 \end{array}$	
		E17	E10		
		E16	E4		
		<i>h. Resistors 3A1A1R1 through 3A1A1R5 or capacitor 3A1A1C1 defective.</i>		<i>h. Check resistors 3A1A1R1 through 3A1A1R5 with an ohmmeter per following table. Replace defective components as necessary.</i>	
		Ohmmeter leads	Reading in ohms	Component	
		+	-	$\pm 20\%$	
		E14	E29	68	3A1A1R1
		E14	E19	68	3A1A1R2
		E28	E23	100	3A1A1R3
		E20	E21	100	3A1A1R4
		E14	E15	560	3A1A1R5
		E9	E18	> 20K	3A1A1C1



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Figure 3-16. Antenna Coupler, Test Point Locations.

e. ± 8 VDC Power Supply Troubleshooting Chart.

Item No	Symptom	Probable trouble	Checks and corrective action
1	± 8 vdc or -8 vdc abnormal.	a. Transistor Q3 defective. b. ± 8 vdc power supply circuit card 3PS1A1 defective. c. Wiring to connector defective.	a. Check transistor Q3 and replace if defective. b. Replace circuit card 3PS1A1. c. Check continuity of wiring and repair as necessary.

3-14. Switched Filter Performance Test

a. Turn power supply, transmitter PWR switch, and amplifier PWR switch to OFF. Verify that transmitter and amplifier are connected as shown in figure 3-10. If equipment is not properly connected, perform paragraph 3-11.

b. Remove switched filter 3A5 from amplifier (para 3-23q).

c. Remove six screws 3A5MP1H1 (fig. 3-23, sheet 5) and flatwashers 3A5MP1H2, and remove cover 3A5MP1.

d. Use cables provided in maintenance kit to reconnect 3A5J2 to 3W2P3 and 3A5J3 to 3W1P10 (not shown). Do not reconnect 3A5J1 at this time.

e. Set ± 28 vdc power supply to ON.

f. Set transmitter PWR switch to ON and select frequency between 200 kHz and 260 kHz.

g. Set amplifier POWER switch to ON.

h. Observe that switched filter motor steps with switch wiper at number 1 position. If switch wiper does not stop at number 1 position, perform troubleshooting flow diagram steps in figure 3-17(A).

i. Set transmitter to following frequencies. If switch wiper does not stop at specified position, perform troubleshooting flow diagram steps of figure 3-17(B).

TRANSMITTER FREQUENCY	SWITCH WIPER POSITION
260-310 kHz	2
310-360 kHz	3
360-535 kHz	4

j. Set amplifier POWER switch to OFF. Set transmitter PWR switch to OFF.

k. Use switched filter extension rf cable provided in maintenance kit to reconnect 3A5J1 to 3W1P9 (not shown).

l. Connect oscilloscope probe to solder terminal of 3A5J2.

m. Set transmitter PWR switch to ON. Adjust transmitter for 228.0 kHz.

n. Set amplifier POWER switch to ON.

o. While amplifier is tuning, observe that oscilloscope displays sine wave at selected frequency. When amplifier tuning cycle is completed, measure 80 ± 20 vac peak signal on oscilloscope. If sine wave or voltage is not obtained, perform troubleshooting flow diagram steps of figure 3-17(C).

p. Set amplifier POWER switch to OFF.

q. Repeat n through p above, with transmitter set at following frequencies:

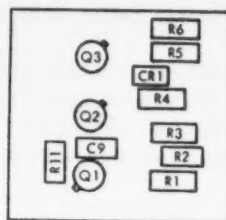
s. Disconnect cables from amplifier and switched filter.

t. Reposition switched filter cover 3A5MP1 (fig. 3-23, sheet 5) and secure with six screws 3A5MP1H1 and flatwashers 3A5MP1H2.

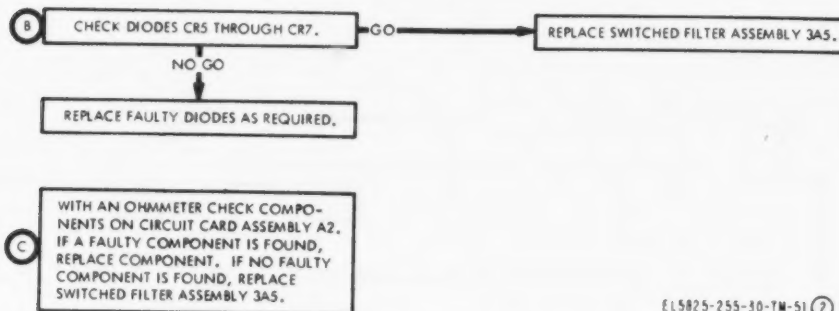
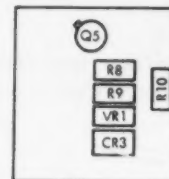
u. Replace switched filter 3A5 (para 3-24i).



CIRCUIT CARD 3A5A1 COMPONENT LOCATION



CIRCUIT CARD 3A5A2 COMPONENT LOCATION



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Figure 3-17. Switched Filter Troubleshooting Flow Diagram (sheet 2 of 2).

Section III. MAINTENANCE OF BEACON SET, RADIO AN/TRN-30(V)

3-15. General

a. This section provides adjustment procedures and removal and replacement procedures. A modulation adjustment (para 3-16 and 3-17) must be performed when any one of the three power amplifier-power supplies in the amplifier is replaced. A TCXO adjustment (para 3-18 and 3-19) must be performed when the TCXO and fixed dividers circuit card 1A6 in the transmitter is replaced.

b. Repairs at direct support maintenance consist of removal and replacement of assemblies, plug-in circuit cards, specific components, and bit parts. Paragraphs 3-21 and 3-22 describe the removal and replacement

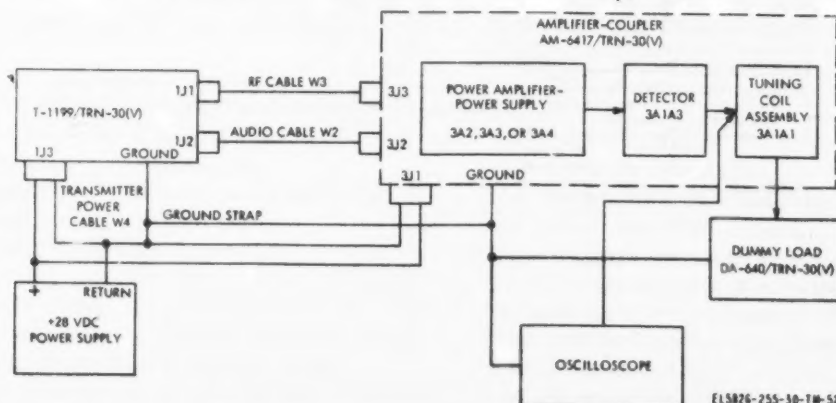
procedures for the transmitter; paragraphs 3-23 and 3-24 for the amplifier.

3-16. Test Setup for Modulation Adjustment

Connect the equipment as shown in figure 3-18 and perform the following steps:

WARNING

Do not touch antenna tuning coil 3A1A4 while power is applied during modulation adjustment. Severe injury or DEATH could result from extremely high rf voltage present on coil windings.



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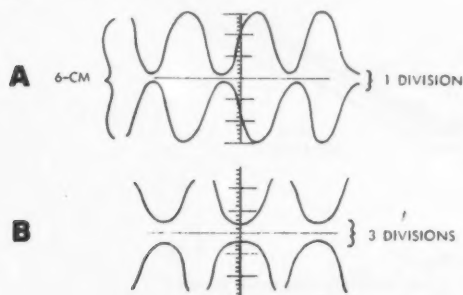
Figure 3-18. Amplifier, Modulation Adjustment Test Setup.

- Remove amplifier cover housing (para 3-23a(1) through (3)).
- Perform the procedure in paragraph 3-11a through h.
- Remove power amplifier-power supplies 3A2, 3A3, and 3A4 (para 3-23j) from amplifier housing and leave cables connected.
- Lay each power amplifier-power supply on bench with heat sinks facing downwards.
- Remove five screws securing cover of each module.
- Remove module covers and lay them to one side.
- Attach oscilloscope probe to inner conductor of coaxial cable that connects to base of antenna tuning coil 3A1A4.
- Connect ground strap between all equipment.
- Set power switch on oscilloscope to ON.
- Calibrate oscilloscope for 1 VOLT/CM.
- Turn on +28 vdc power supply and adjust for $+28 \pm 0.5$ vdc if necessary.
- Set transmitter PWR switch and amplifier POWER switch to ON.

3-17. Modulation Adjustment

Connect the equipment as described in paragraph 3-16 and as shown in figure 3-18 and perform the following steps:

- While holding transmitter MODE switch in KEY position, adjust resistor 3A()A5R24 (fig. 3-13) for modulation envelope with minimum distance between waveform envelope valleys.
- Adjust VOLT/CM switch and variable gain on oscilloscope until peak-to-peak modulation fills vertical scale.
- Repeat a and b above until ratio between envelope valleys and peak-to-peak vertical deflection, as shown in figure 3-19, is 1/30. Note distance between envelope valleys.



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Figure 3-19. Modulation Adjustment Waveforms.

NOTE

Do not over adjust 3A()A5R24 or the rf signal will be cut off.

- Adjust VOLT/CM switch for next more sensitive

range. Do not adjust variable gain control.

- Adjust 3A()A5R24 so that the minimum distance between envelope valleys (fig. 3-18) is three times that noted in c above.
- Turn PUSH TO TURN selection switch on amplifier to TACTICAL 2.
- Repeat a through e above for power amplifier-power supply 3A3.
- Turn PUSH TO TURN selection switch on amplifier to TACTICAL 3.
- Repeat a through e above for power amplifier-power supply 3A4.
- Turn all equipment power off.
- Disconnect oscilloscope probe.
- Replace all power amplifier-power supply covers and secure.
- Replace all power amplifier-power supplies and secure.
- Replace amplifier cover housing (para 3-24y(5) through (9)).
- Disconnect all other cables and equipment.

3-18. Test Setup for TCXO Adjustment

Connect the equipment as shown in figure 3-20 and perform the following steps:

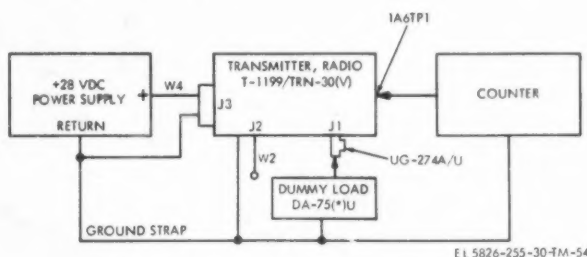


Figure 3-20. TXCO, Adjustment Test Setup.

- Set transmitter PWR switch to OFF.
- Remove transmitter bottom cover (para 3-21a).
- Connect audio cable assembly W2 to AUDIO connector 1J2.
- Connect Dummy Load DA-75/U through T-adaptor (UG-274A/U) to rf connector 1J1.
- Connect counter to test point 1A6TP1 on TCXO and dividers circuit card 1A6.
- Connect $+28 \pm 0.5$ vdc, 5 ampere power supply to input power connector 1J3 using transmitter external power cable W4.
- Turn on counter power.
- Set counter to read 3 MHz signal.
- Turn on power supply and adjust for $+28 \pm 0.5$ vdc.
- Set transmitter PWR switch to ON.
- Readjust power supply as required.
- Allow transmitter 10 minutes to warm up before adjusting TCXO.

3-21. Transmitter Removal Procedures

The following instructions are for removal of assemblies, circuit cards, and component parts from the transmitter. See figure 3-21 for the locations of components.

WARNING

Turn OFF all power to the transmitter before any disassembly procedure is performed.

a. Bottom Cover 1A13

- (1) Turn open relief valve (RV) on front panel.
- (2) Turn transmitter upside down.

(3) Unsnap 10 spring clamps securing bottom cover 1A13 (sheet 1) to transmitter case 1A12.

(4) Remove bottom cover 1A13.

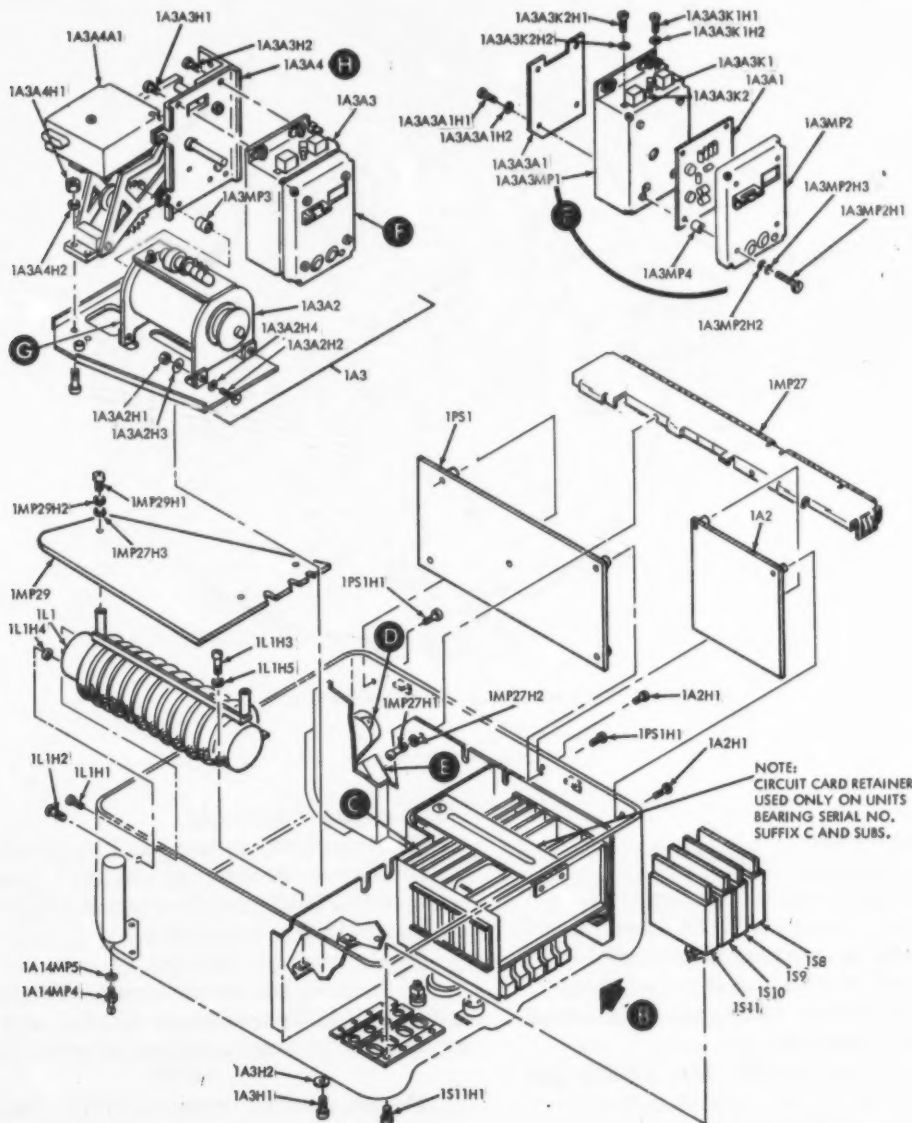
b. Interconnect Circuit Card 1A1.

(1) Remove circuit cards 1A4 through 1A11 (q below).

(2) Remove four screws 1A1H1 (sheet 3) and flatwashers 1A1H2.

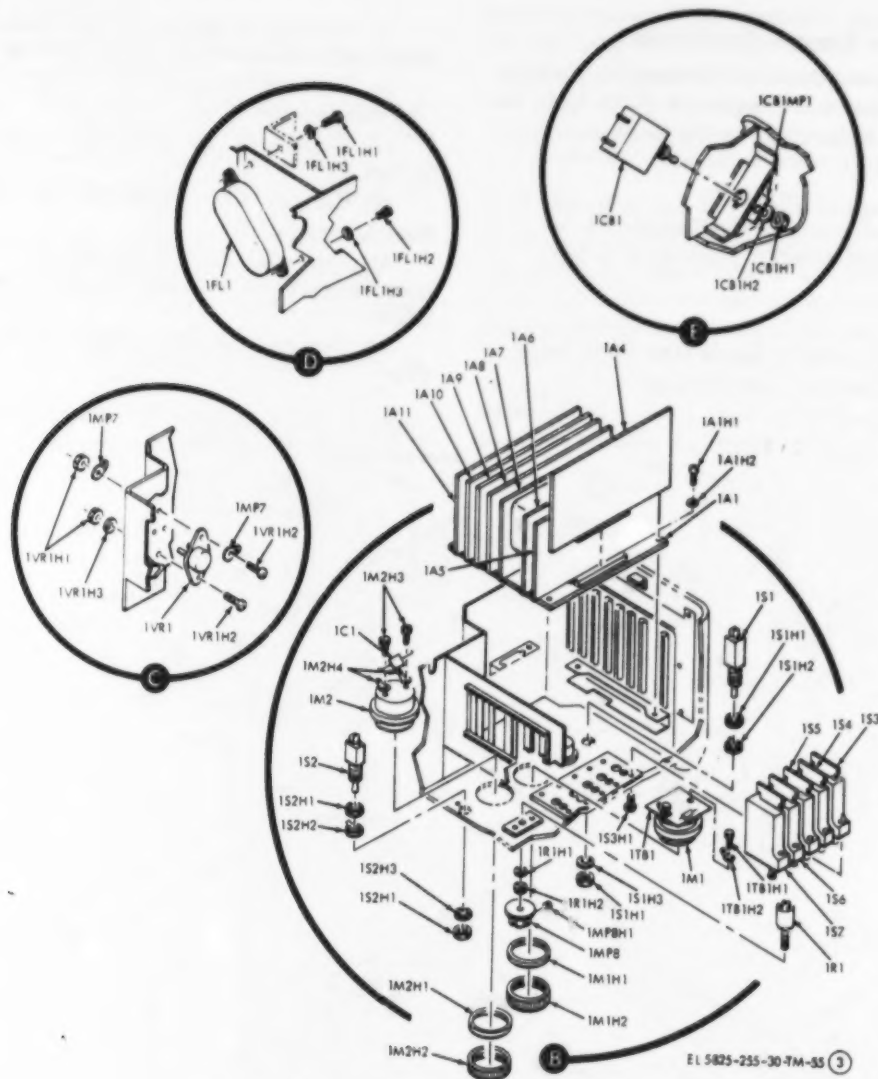
(3) Lift interconnect circuit card from end of board labeled A4 for easier access to solder connections.

(4) Tag and unsolder wires connected to underside



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Figure 3-21(2). Transmitter, Exploded View (Sheet 2 of 6).



of circuit card.

(5) Remove circuit card.

c. *Rf Amplifier Circuit Card 1A2.*

(1) Remove bottom cover 1A13 (a above).

(2) Remove two screws 1MP27H1 (sheet 2) and washers 1MP27H2 securing rf shield assembly 1MP27 to transmitter and lift rf shield out of transmitter.

(3) Remove 10 screws 1A2H1 securing circuit card 1A2 to side of transmitter.

(4) Disconnect plugs 1A2P1 and 1A2P2 (not shown).

(5) Lift circuit card 1A2 from transmitter.

(6) Disconnect plug 1PS1P2 (not shown).

(7) Remove circuit card 1A2 from transmitter.

d. *Antenna Coupler 1A3.*

(1) Remove bottom cover 1A13 (a above).

(2) Remove three screws 1MP29H1 (sheet 2), lockwashers 1MP29H2, and flatwashers 1MP29H3 securing plate 1MP29 to transmitter.

(3) Remove plate 1MP29.

(4) Remove four screws (one 1L1H1, one 1L1H2, and two 1L1H3), one spacer 1L1H4, and two flatwashers 1L1H5 securing tapped inductor 1L1.

NOTE

NOTE
Do not unsolder wires connecting inductor 1L1 and motor drive assembly 1A3A4 unless the inductor or motor drive assembly is to be replaced.

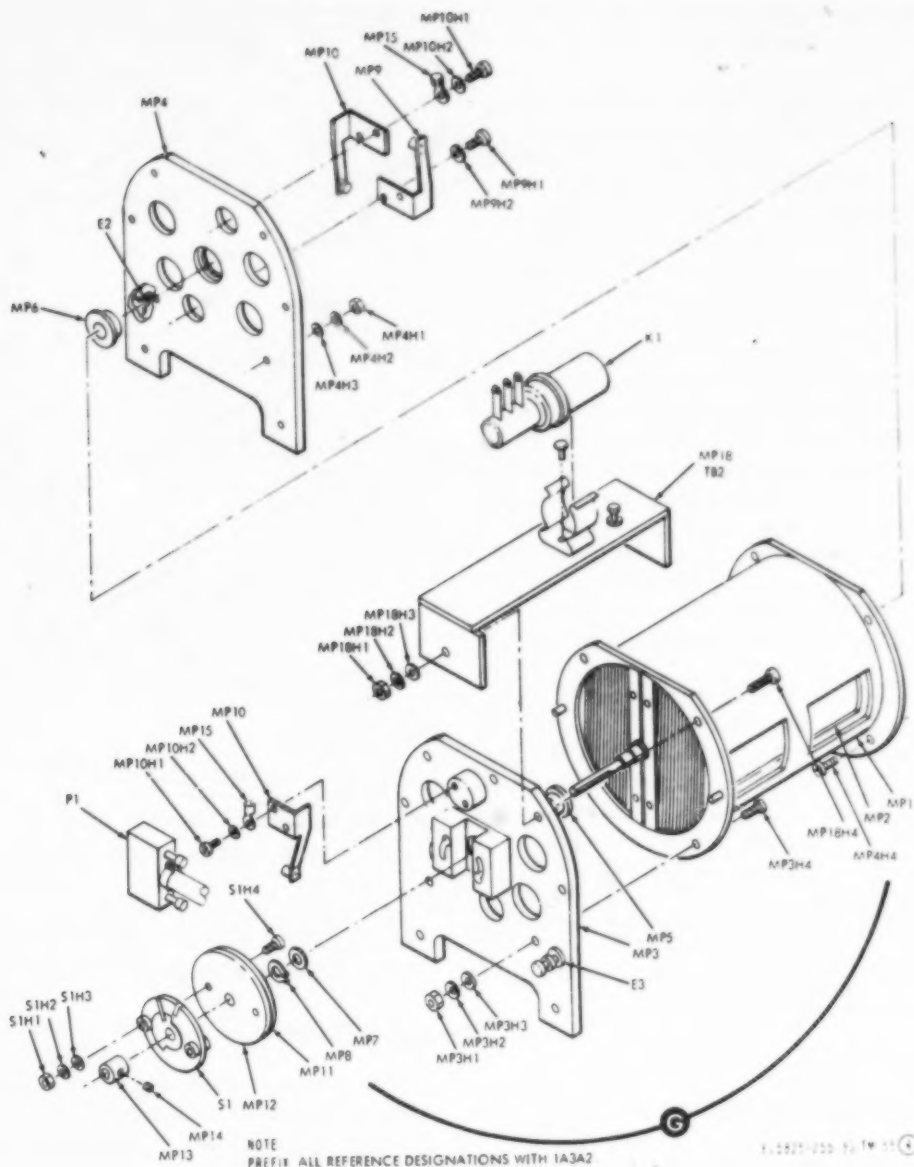


Figure 3-21. Transmitter. Exploded View (Sheet 4 of 6).

(5) Disconnect plugs 1A1P2, 1W1P1, 1A2P2, 1P2, 1P3, and 1P5 (not shown).

(6) Unsolder wire from E1 of 1J4 (not shown).

(7) Remove screw 1FL1H1 (sheet 3) and flatwasher 1FL1H3 securing top of antenna coupler and input line filter 1FL1.

(8) Remove four screws 1A3H1 (sheet 2) and washers 1A3H2 securing antenna coupler to transmitter.

(9) Lift antenna coupler and attached tapped inductor 1L1 out of transmitter.

e. Detector Circuit Card 1A3A1.

(1) Remove antenna coupler 1A3 (d above).

(2) Remove plug 1A3A2P1 (not shown) from retaining bracket on detector cover 1A3MP2 (sheet 2).

(3) Disconnect wire from E1 on detector circuit card 1A3A1.

(4) Remove four screws 1A3MP2H1, lockwashers 1A3MP2H3, and flatwashers 1A3MP2H2 that retain detector cover 1A3MP2.

(5) Remove detector cover 1A3MP2 and four standoffs 1A3MP4.

(6) Pull detector circuit card 1A3A1 away from switched filter 1A3A3.

f. Variometer Coils 1A3A2L2 and 1A3A2L3.

(1) Remove antenna coupler 1A3 (d above).

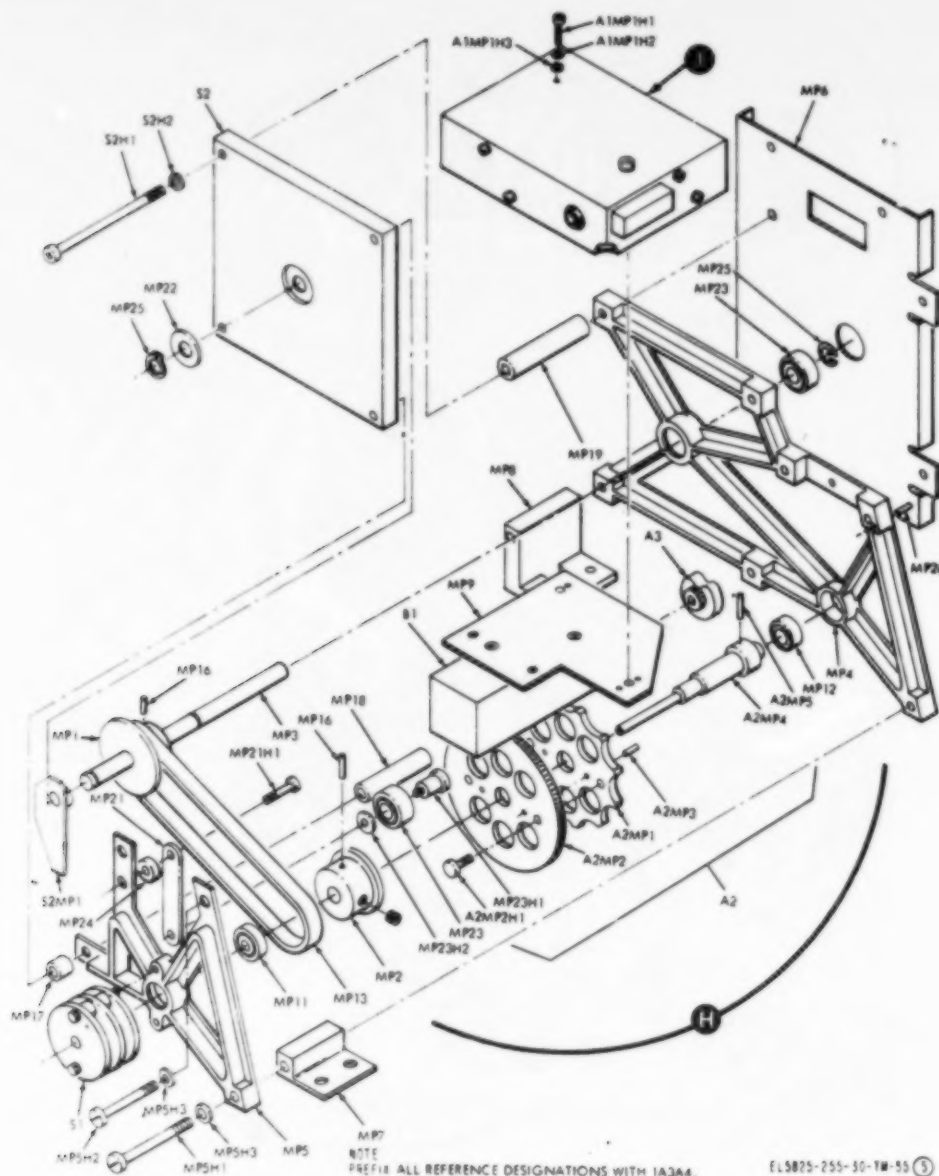


Figure 3-21. Transmitter, Exploded View (Sheet 5 of 6).

(2) Loosen and remove plug 1A3A2P1 (sheet 4) from detector cover 1A3MP2 (sheet 2).

(3) Tag and unsolder both wires connected to E3 on variometer front plate 1A3A2MP3 (sheet 4). Tag and disconnect wire from E1 on rear plate 1A3A2MP4. Tag and unsolder wire from E2 of terminal board 1A3A2MP18TB2.

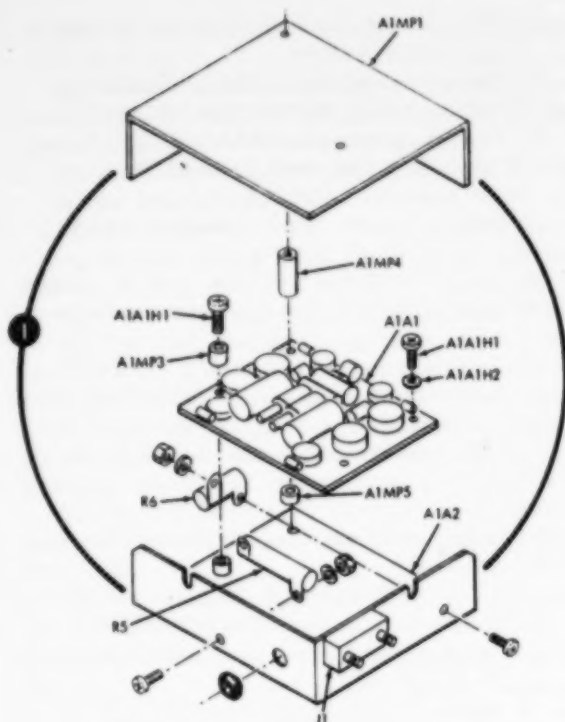
(4) Mark adapter 1A3A2MP13 and coupling 1A3MP3 (sheet 2) with a reference line so that inner variometer coil can be correctly repositioned during reassembly. Remove four screws 1A3A2H2, nuts 1A3A2H1, lockwashers 1A3A2H4, and flatwashers

1A3A2H3. Remove variometer 1A3A2.

(5) Loosen two setscrews in part of coupling 1A3MP3 that remains attached to variometer shaft. Remove coupling.

(6) Loosen one setscrew in adapter 1A3A2M (sheet 4) and remove adapter.

(7) Note positions of switch contacts so switch can be properly installed during reassembly. Remove two nuts 1A3A2S1H1, lockwashers 1A3A2S1H2, and flatwashers 1A3A2S1H3. Rotate switch 1A3A clockwise and remove from mount. Remove screws 1A3A2S1H4. Slide switch and switch



NOTE
PREFIX ALL REFERENCE DESIGNATIONS WITH 1A3A4

EL5825-255-30-TM-55 ©

Figure 3-21. Transmitter, Exploded View (Sheet 6 of 6).

insulators 1A3A2MP11 and 1A3A2MP12 from inner variometer coil shaft.

(8) Remove two screws 1A3A2MP18H4, nuts 1A3A2MP18H1, lockwashers 1A3A2MP18H2, and flatwashers 1A3A2MP18H3. Remove terminal board 1A3A2MP18TB2.

(9) Unsolder outer variometer coil wire from E2 on rear plate 1A3A2MP4.

(10) On rear plate 1A3A2MP4, remove screw 1A3A2MP10H1 and lockwasher 1A3A2MP10H2, and disconnect lug 1A3A2MP15 from spring contact 1A3A2MP10.

(11) Remove three screws 1A3A2MP4H4, nuts 1A3A2MP4H1, lockwashers 1A3A2MP4H2, and flatwashers 1A3A2MP4H3. Slide variometer rear plate 1A3A2MP4 over shaft until clear of shaft. Then swing variometer rear plate up to expose variometer inner coil.

(12) On front plate 1A3A2MP3, remove two screws 1A3A2MP10H1, and lockwashers 1A3A2MP10H2. Remove lug 1A3A2MP15 and spring contact 1A3A2MP10.

(13) Remove retaining clip 1A3A2MP8 and washer 1A3A2MP7.

(14) Slide inner coil 1A3A2MP2 from variometer. Do not misplace front bushing 1A3A2MP5 or rear bushing 1A3A2MP6.

g. Variometer Coils 1A3A2L1 and 1A3A2L4.

(1) Perform the procedures in f(1) through (11) above.

(2) Cut lugs 1A3A2MP15 (sheet 4, two places) from wires that protrude through front and rear plates 1A3A2MP3 and 1A3A2MP4.

(3) Remove rear plate 1A3A2MP4.

(4) Remove three screws 1A3A2MP3H4, nuts 1A3A2MP3H1, lockwashers 1A3A2MP3H2, and flatwashers 1A3A2MP3H3.

(5) Remove outer variometer coils 1A3A2L1 and 1A3A2L4 (1A3A2MP1, two places).

h. Switched Filter 1A3A3.

(1) Remove antenna coupler 1A3 (d above).

(2) Remove detector circuit card 1A3A1 (e above).

(3) Remove four screws (three 1A3A3H1 and one 1A3A3H2, sheet 2) securing switched filter 1A3A3 to motor drive assembly 1A3A4.

(4) Remove bracket and pull switched filter 1A3A3 away from motor drive assembly 1A3A4.

i. Circuit Card 1A3A3A1.

(1) Remove switched filter 1A3A3 (h above).

(2) Tag and unsolder one wire connected to switch S1 (not shown).

(3) Remove four screws 1A3A3A1H1 (sheet 2) and lockwashers 1A3A3A1H2 and carefully lift circuit card 1A3A3A1 from supports to expose connections on S2 side of board.

(4) Tag and unsolder four remaining connections to circuit card 1A3A3A1.

(5) Remove circuit card 1A3A3A1.

j. Relays 1A3A3K1 and 1A3A3K2. The procedure to remove 1A3A3K2 is the same as for 1A3A3K1, below:

(1) Remove circuit card 1A3A3A1 (i above).

(2) Slide insulation sleeving away from relay terminals.

CAUTION

Do not damage diode while unsoldering wires in next step.

(3) Note diode polarity. Tag and unsolder wires and diode connected to relay terminals.

(4) Remove two screws 1A3A3K1H1 (sheet 2) and flatwashers 1A3A3K1H2. Remove relay 1A3A3K1.

k. Motor Drive Assembly 1A3A4.

(1) Remove switched filter 1A3A3 (h above).

(2) Tag and disconnect 13 wires from high voltage switch 1A3A4S2 (sheet 5).

(3) Remove four nuts 1A3A4H1 (sheet 2) and lockwashers 1A3A4H2.

(4) Carefully remove motor drive assembly 1A3A4. Retain nylon coupling block from coupling 1A3MP3.

l. Servoamplifier 1A3A4A1.

(1) Perform the procedures in d(1) through (8) above.

(2) Partially lift antenna coupler 1A3 (sheet 2) out of housing.

(3) Remove two screws 1A3A3A1MP1H1 (sheet 5), lockwashers 1A3A4A1MP1H2, and flatwashers 1A3A4A1MP1H3 that secure servoamplifier 1A3A4A1 (sheet 2) to motor drive assembly 1A3A4.

(4) Carefully slide servoamplifier 1A3A4A1 from under wires connected to coil 1L1. Do not damage wires connected to servoamplifier.

(5) Remove servoamplifier cover 1A3A4A1MP1 (sheet 6) and two spacers 1A3A4A1MP4.

(6) Remove two screws 1A3A4A1A1H1, one flatwasher 1A3A4A1A1H2, spacer 1A3A4A1MP3, and spacers 1A3A4A1MP5.

(7) If servoamplifier is to be tested, carefully turn circuit card 1A3A4A1A1 so that foil side of circuit card is exposed. Refer to figure 3-9 for troubleshooting flow diagram and for test point locations.

(8) If servoamplifier is to be removed, tag and unsolder wires connected to circuit card 1A3A4A1A1 and remove circuit card.

m. High Voltage Switch 1A3A4S2.

(1) Remove motor drive assembly 1A3A4 (*k* above).

(2) Loosen screw 1A3A4MP21H1 (sheet 5) and adjust idler arm to slacken drive belt 1A3A4MP13.

(3) Remove retaining ring 1A3A4MP25 and spacer 1A3A4MP22. There may be several spacers similar to 1A3A4MP22 between retaining ring and high voltage switch. Retain all spacers.

(4) Remove four screws 1A3A4S2H1, flatwashers 1A3A4S2H2, four spacers (two 1A3A4MP19, one 1A3A4MP17, and one 1A3A4MP18), and one rear support 1A3A4MP8. Remove switch 1A3A4S2.

(5) Remove spring pin from rotor 1A3A4S2MP1. Loosen rotor setscrews and remove rotor 1A3A4S2MP1 from high voltage shaft 1A3A4MP3.

n. Belt 1A3A4MP13.

(1) Remove motor drive assembly 1A3A4 (*k* above).

(2) Perform the procedures in *M*(2), (3), and (4) above.

(3) Remove three screws (one 1A3A4MP5H1, sheet 5, and two 1A3A4MP5H2), flatwashers 1A3A4MP5H3, and one front support 1A3A4MP7.

(4) Carefully pull frame support No. 2 1A3A4MP5 away from motor drive assembly 1A3A4. Frame support No. 2 should be moved far enough to clear end of tuner gear shaft 1A3A4A2MP4.

(5) Slip drive belt 1A3A4MP13 from pulleys and remove.

o. Tuner Gear Assembly 1A3A4A2.

(1) Remove drive belt 1A3A4MP13 (*n* above).

(2) Carefully remove tuner gear assembly 1A3A4A2 (sheet 5).

(3) Remove spring pin 1A3A4MP16 from pulley

1A3A4MP2 and remove pulley from tuner gear assembly shaft 1A3A4A2MP4.

(4) Remove two screws 1A3A4A2MP2H1 and 1 roll pins 1A3A4A2MP3. Remove disk 1A3A4A2MP.

(5) Remove spring pin 1A3A4A2MP5. Remove gear 1A3A4A2MP2 from shaft 1A3A4A2MP4.

p. Driver Assembly 1A3A4A3.

(1) Remove motor drive assembly 1A3A4 above).

(2) Loosen setscrews in brass hub of coupler 1A3MP3 (sheet 2) on motor shaft and remove brass hub.

(3) Remove spring pin 1A3A4MP20 (sheet 5).

(4) Remove two screws 1A3A4MP5H2 and flatwashers 1A3A4MP5H3.

(5) Lift amplifier and motor mounting bracket 1A3A4MP9 to gain access to driver assembly 1A3A4A3.

(6) Loosen two setscrews and remove driver assembly 1A3A4A3.

q. Circuit Cards 1A4 through 1A11.

(1) Remove bottom cover 1A13 (*a* above).

(2) Use circuit card extractor to pull card straight up and out of transmitter (sheet 3).

NOTE

If TCXO and fixed dividers circuit card 1A6 is to be replaced, refer to paragraph 3-19 for adjustment of the TCXO.

r. Power Supply Circuit Card 1PS1.

(1) Remove bottom cover 1A13 (*a* above).

(2) Remove two screws 1MP27H1 (sheet 2) and washers 1MP27H2 securing RF shield 1MP27 to transmitter. Lift RF shield 1MP27 out of transmitter.

(3) Remove five screws 1PS1H1 securing power supply circuit card 1PS1 to side of transmitter case.

(4) Partially remove power amplifier 1A2 by performing the procedures in *c*(1), (2), and (3) above.

(5) Disconnect plugs 1P4, 1PS1P1, and 1PS1P2 (not shown).

(6) Lift 1PS1 out of transmitter.

s. Input Line Filter 1FL1.

(1) Remove antenna coupler (*d* above).

(2) Remove remaining screw 1FL1H2 (sheet 3) and washer 1FL1H3 securing filter 1FL1 to transmitter.

(3) Tag and unsolder wires connected to filter 1FL terminals.

(4) Remove filter 1FL1 from transmitter.

t. Circuit Breaker 1CB1.

(1) Remove bottom cover 1A13 (*a* above).

(2) Remove two screws 1MP27H1 (sheet 2) and washers 1MP27H2 securing RF shield 1MP27. Lift RF shield 1MP27 out of transmitter.

(3) Remove power supply circuit card 1PS1 above).

(4) Remove input line filter 1FL1 (*s* above).

(5) Tag and unsolder wires from circuit breaker CBI (sheet 3).

(6) Remove outside retaining nut 1CB1H1, lockwasher 1CB1H2, and ON OFF plate 1CB1MP1 securing circuit breaker 1CB1 to transmitter case.

(7) Push circuit breaker 1CB1 inwards and remove from transmitter.

u. Zener Diode 1VR1.

(1) Remove circuit cards 1A4 through 1A11 (q above).

(2) Remove antenna coupler 1A3 (d above).

(3) Tag and unsolder wires from diode 1VF1 (sheet 3).

(4) Remove four screws 1A1H1 and washers 1A1H2 retaining interconnect circuit card 1A1.

(5) Move interconnect circuit card 1A1 away from 1VF1.

(6) Remove two screws 1VR1H2, nuts 1VR1H1 terminal lugs 1MP7, and one lockwasher 1VR1H3 from 1VR1.

(7) Remove diode 1VR1.

v. CODE RATE Control 1R1.

(1) Remove circuit cards 1A4 through 1A11 (q above).

(2) Remove four screws 1A1H1 (sheet 3) and washers 1A1H2 retaining interconnect circuit card 1A1.

(3) Lift interconnect circuit card 1A1 up and away from control 1R1.

(4) Tag and unsolder wires from control 1R1.

(5) Loosen setscrew 1MP8H1 and remove control knob 1MP8.

(6) Remove retaining nut 1R1H2 and washer 1R1H1 securing control 1R1 to transmitter.

(7) Push control 1R1 inward and remove from transmitter.

w. Transistors 1Q1 and 1Q2. The procedure to remove 1Q1 is the same as for 1Q2, below:

(1) Remove power supply circuit card 1PS1 (r above).

(2) Remove RF amplifier circuit card (c above).

(3) Remove four screws 1MP4H1 (sheet 1) securing transistor cover 1MP4 to side of transmitter. Remove cover 1MP4 with attached gasket.

(4) Tag and unsolder wires from terminals of transistor 1Q2.

(5) Remove two screws 1A2H2, nuts 1A2H1, flatwashers 1Q2H4, bushings 1MP17, and one terminal 1MP19 and lockwasher 1Q2H3.

(6) Remove transistor 1Q2 and insulator 1MP16.

x. Tapped Inductor 1L1.

(1) Remove bottom cover 1A13 (a above).

(2) Remove three screws 1MP29H1 (sheet 2), lockwashers 1MP29H2, and flatwashers 1MP29H3 securing plate 1MP29 to transmitter.

(3) Remove plate 1MP29.

(4) Tag and unsolder wires from tapped inductor 1L1.

(5) Remove four screws (one 1L1H1, one 1L1H2, and two 1L1H3) two flatwashers 1L1H5, and one spacer 1L1H4 securing 1L1.

(6) Remove tapped inductor 1L1.

y. CODE Switches 1S8 through 1S11.

(1) Remove bottom cover (a above).

(2) Tag and unsolder wires from switch to be removed (sheet 2).

(3) Remove two screws 1S11H1 securing switch.

(4) Push switch inward and remove from transmitter.

z. MODE Switch 1S2 and ANTENNA Switch 1S1. The procedure to remove ANTENNA switch 1S1 is the same as for 1S2, below:

(1) Remove bottom cover (a above).

(2) Tag and unsolder wires from switch 1S2 (sheet 3).

(3) Remove retaining nut 1S2H1 and washer 1S2H3.

(4) Push switch 1S2 inward and remove from transmitter. Retain seal 1S2H2 and nut 1S2H1.

aa. FREQUENCY KHZ Switches 1S3 through 1S7.

(1) Remove circuit cards 1A4 through 1A11 (q above).

(2) Remove four screws 1A1H1 (sheet 3) and washers 1A1H2 securing interconnect circuit card 1A1.

(3) Lift interconnect circuit card 1A1 up and away from switches 1S3 through 1S7.

(4) Tag and unsolder wires from switch to be removed.

(5) Remove two screws 1S3H1 securing switch.

(6) Push switch inward and remove from transmitter.

ab. VOLTAGE Meter 1M1.

(1) Remove circuit cards 1A4 through 1A11 (q above).

(2) Remove four screws 1A1H1 (sheet 3) and washers 1A1H2 securing interconnect circuit card 1A1.

(3) Lift interconnect circuit card 1A1 up and away from meter 1M1.

(4) Remove two hex head screws 1TB1H1 securing terminal board 1TB1 and lugs 1TB1H2 to meter.

(5) Lift terminal board up and away from meter.

(6) Remove two retaining rings 1M1H2 and 1M1H1 securing meter 1M1 to transmitter case.

(7) Push meter 1M1 inward and remove from transmitter.

ac. RF Meter 1M2.

(1) Remove circuit cards 1A4 through 1A11 (q above).

(2) Remove four screws 1A1H1 (sheet 3) and washers 1A1H2 securing interconnect circuit card

1A1.

(3) Lift interconnect circuit card up and away from meter 1M2.

(4) Tag wires and remove two screws 1M2H3 securing terminal lugs 1M2H4 to meter 1M2 terminals.

(5) Remove two retaining rings 1M2H2 and 1M2H1 securing meter 1M2 to transmitter case.

(6) Push meter 1M2 inward and remove from transmitter.

3-22. Transmitter Replacement Procedures

The following instructions are for the replacement of assemblies, circuit cards, or component parts removed from the transmitter. See figure 3-21 for the locations of components.

a. RF Meter 1M2.

(1) Insert meter 1M2 (sheet 3) in designated hole in transmitter and secure with two retaining rings 1M2H1 and 1M2H2.

(2) Connect terminal lugs 1M2H4 to correct meter terminals using two hex head screws 1M2H3.

(3) Place interconnect circuit card 1A1 in position and secure with four screws 1A1H1 and washers 1A1H2.

(4) Install circuit cards 1A4 through 1A11 (*m* below).

b. VOLTAGE Meter 1M1.

(1) Insert meter 1M1 (sheet 3) in designated hole in transmitter and secure with two retaining rings 1M1H1 and 1M1H2.

(2) Place terminal board 1TB1 and lugs 1TB1H2 in position on meter and secure with two hex head screws 1TB1H1.

(3) Place interconnect circuit card 1A1 in position and secure with four screws 1A1H1 and washers 1A1H2.

(4) Install circuit cards 1A4 through 1A11 (*m* below).

c. FREQUENCY KHZ Switches 1S3 through 1S7.

(1) Apply grade HV locking compound (MIL-S-22473) to two screws 1S3H1 (sheet 3) for each switch to be installed.

NOTE

When installing a new switch, discard gasket supplied with switch.

(2) Insert switch in designated hole in transmitter case and secure with screws from above step. Torque screws to 10 inch-ounces.

(3) Solder wires to correct switch terminals

(4) Place interconnect circuit card 1A1 in position and secure with four screws 1A1H1 and washers 1A1H2.

(5) Install circuit cards 1A4 through 1A11 (*m* below).

d. MODE Switch 1S2 and ANTENNA Switch 1S1. The procedure to replace ANTENNA switch 1S1 is the same as for 1S2, below:

(1) Verify that a nut 1S2H1 (sheet 3) and seal 1S2H2 are installed on switch 1S2.

(2) Insert switch through designated hole in transmitter case and secure with retaining washer 1S2' and nut 1S2H1.

(3) Solder wires to correct switch terminals.

e. CODE Switches 1S8 through 1S11.

(1) Apply silicone grease SM-A-726156-1 (Silicon Products G-300) to O-ring gaskets of two screws 1S11H1 (sheet 2) for each switch to be replaced and apply grade HV locking compound (MIL-S-22473) to screw threads.

(2) Insert switch through designated hole in transmitter case and secure with screws from above step. Torque screws to 4 inch-pounds.

(3) Solder wires to correct switch terminals.

f. Tapped Inductor 1L1.

(1) Apply silicone grease SM-A-726156-1 (Silicon Products G-300) to O-ring gaskets of two screws 1L1H1 and 1L1H2 (sheet 2) and apply grade HV locking compound (MIL-S-22473) to screw threads.

(2) Place tapped inductor 1L1 in position and secure with two screws from above step, spacer 1L1H4, two screws 1L1H3, and flatwashers 1L1H5. Torque screws 1L1H1 and 1L1H2 to 4 inch-pounds.

(3) Solder wires to correct terminals on inductor

(4) Place plate 1MP29 in position and secure with three screws 1MP29H1, lockwashers 1MP29H2, and flatwashers 1MP29H3.

(5) Install bottom cover 1A13 (sheet 1) and secure with ten spring clamps.

g. Transistors 1Q1 and 1Q2. The procedure to replace 1Q1 is the same as for 1Q2, below:

(1) Apply heat transfer compound SM-A-726154-1 (Dow Corning DC-340) to both sides of transistor insulator 1MP16 (sheet 1).

(2) Place transistor 1Q2 and insulator 1MP16 in position on side of transmitter case.

(3) Install two screws 1Q2H2, bushings 1MP17, flatwashers 1Q2H4, lockwashers 1Q2H3, terminal lug 1MP19, and nuts 1Q2H1 to secure transistor 1Q2 to transmitter

(4) Solder wires to correct terminals on transistor.

(5) Apply silicone grease SM-A-726156-1 (Silicon Products G-300) to O-ring gaskets on four screws 1MP4H1 and apply grade HV locking compound (MIL-S-22473) to screw threads.

(6) Place transistor cover 1MP4 over transistor 1Q2 and secure with screws from above step. Torque screws to 4 inch-pounds.

(7) Install rf amplifier circuit card 1A2 and power supply circuit card 1PS1 (*aa* and *l* below, respectively).

h. CODE RATE Control 1R1.

- (1) Insert shaft of control 1R1 (sheet 3) through hole in transmitter case with shaft pointing outward.
- (2) Install washer 1R1H1 and retaining nut 1R1H2 to secure control 1R1 to transmitter.
- (3) Solder wires to correct terminals on control.
- (4) Rotate control shaft fully ccw.
- (5) Install control knob 1MP8 with pointer at position 7 and tighten setscrew 1MP8H1.
- (6) Place interconnect circuit card 1A1 in position and secure with four screws 1A1H1 and washers 1A1H2.
- (7) Install circuit cards 1A4 through 1A11 (*m* below).

i. Zener Diode 1VR1.

- (1) Place zener diode 1VR1 (sheet 3) in position and secure with two screws 1VR1H2, terminal lugs 1MP7, nuts 1VR1H1, and one lockwasher 1VR1H3.
- (2) Solder wires to correct terminals on diode 1VR1.
- (3) Place interconnect circuit card 1A1 in position and secure with four screws 1A1H1 and washers 1A1H2.
- (4) Install circuit cards 1A4 through 1A11 (*m* below).
- (5) Install antenna coupler 1A3 (*z* below).

j. Circuit Breaker 1CB1.

- (1) If replacement circuit breaker is provided with new mounting hardware, discard the old hardware removed in paragraph 3-21*t*. Also discard lock ring provided with new circuit breaker.
- (2) Insert new circuit breaker 1CB1 (sheet 3) into designated hole in transmitter and secure with ON-OFF plate 1CB1MP1, retaining lockwasher 1CB1H2, and nut 1CB1H1.
- (3) Solder wires to correct terminals on circuit breaker 1CB1.

- (4) Install input line filter 1FL1 (*k* below).
- (5) Install power supply circuit card 1PS1 (*l* below).
- (6) Install antenna coupler 1A3 (*z* below).
- (7) Place rf shield 1MP27 (sheet 2) in position and secure with two screws 1MP27H1 and washers 1MP27H2.

k. Input Line Filter 1FL1.

- (1) Place input line filter 1FL1 (sheet 3) in position and secure with one washer 1FL1H3 and one screw 1FL1H1.
- (2) Solder wires to correct terminals of filter 1FL1.
- (3) Install antenna coupler 1A3 (*z* below).

l. Power Supply Circuit Card 1PS1.

- (1) Partially insert power supply circuit card 1PS1 (sheet 2) into position in transmitter and connect plugs 1PS4, 1PS1P1, and 1PS1P2 (not shown).
- (2) Apply silicone grease SM-A-726156-1 (Sili-

con Products G-300) to O-ring gaskets of five screws 1PS1H1 and apply grade HV locking compound (MIL-S-22473) to screw threads.

(3) Position power supply circuit card 1PS1 and secure to side of transmitter case using screws from above step. Torque screws to 4 inch-pounds.

(4) Place rf shield 1MP27 in position and secure with two screws 1MP27H1 and washers 1MP27H2.

(5) Install bottom cover 1A13 (sheet 1) and secure with 10 spring clamps.

m. Circuit Cards 1A4 through 1A11.

- (1) Insert each card into its proper position (sheet 3).
- (2) Push down on each card firmly until seated.

NOTE

Units produced before serial number suffix C do not utilize the hinged circuit card retainer referred to in following step.

(3) Fasten circuit card retainer and install bottom cover assembly 1A13 (sheet 1) into position. Secure with twelve spring clamps.

n. Driver Assembly 1A3A4A3.

(1) Position new driver assembly 1A3A4A3 (sheet 5) on motor shaft and secure with two setscrews.

(2) Reposition amplifier and motor mounting bracket 1A3A4MP9. If driver assembly does not properly mesh with tuner gear assembly, reposition driver assembly on motor shaft.

(3) Replace two screws 1A3A4MP5H2 and flatwashers 1A3A4MP5H3. Do not tighten.

(4) Replace spring pin 1A3A4MP20. Tighten two screws installed in previous step.

(5) Replace motor drive assembly 1A3A4 (*s* below).

o. Tuner Gear Assembly 1A3A4A2.

(1) Install disk 1A3A4A2MP1 (sheet 5). Center scallop of disk on center line of gear tooth as shown in C, figure 3-22. Disk must be concentric with outside diameter of gear. Open pilot hole in disk to 0.0937 +0.000 -0.0005 inch diameter and install two roll pins 1A3A4A2MP3.

(2) Mark center of threaded holes in disk onto gear. Remove roll pins and disk and drill two 0.143 to 0.148 inch diameter holes through gear.

(3) Position gear 1A3A4A2MP2 on shaft as shown in F, figure 3-22. Adjust shaft 1A3A4A2MP4 so that the flat sides are parallel with the centerline of the two holes for screws as shown in D, figure 3-22. With gear so positioned, open pilot hole in gear hub to 0.061 to 0.066 inch diameter hole through shaft and other side of gear hub. Install spring pin 1A3A4A2MP5 through gear and shaft. Remove setscrew from gear.

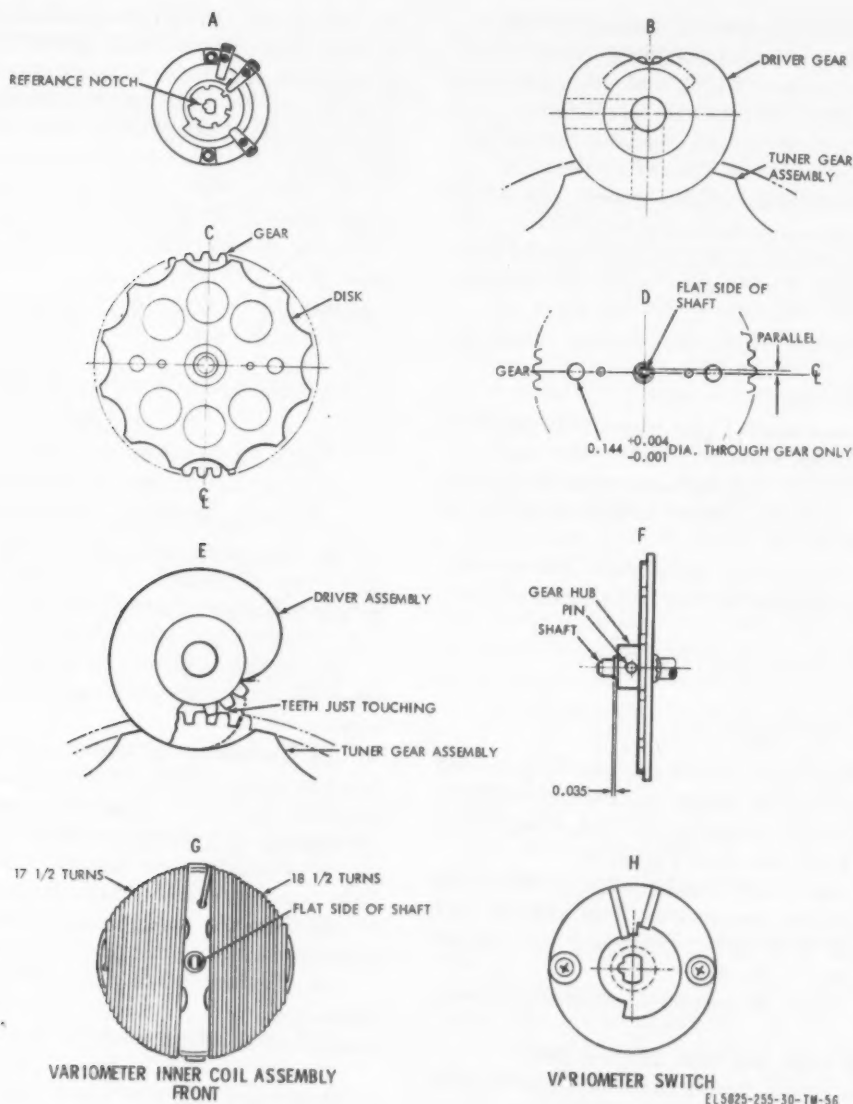


Figure 3-22. Motor Drive Assembly, Alignment.

(4) Reposition disk on gear and reinstall roll pins.

(5) Apply sealing and locking compound grade A per MIL-S-22473 to threads of two screws 1A3A4A2MP2H1 and install screws through gear into disk. Make sure alignment of gear and disk is maintained.

(6) Replace pulley 1A3A4MP2 over tuner gear shaft 1A3A4A2MP4.

(7) Tag and disconnect wires to drive motor 1A3A4B1. Apply +15 vdc to motor to position drive gear assembly 1A3A4A3 as shown in B, figure 3-22.

(8) Align tuner gear so that flat sides of shaft are parallel with vertical centerline drawn through cen-

ter of shaft. Then engage tuner gear scallop with drive gear 1A3A4A3 and tuner gear shaft 1A3A4A2MP4 with bearing 1A3A4MP12.

(9) Adjust front section of logic switch 1A3A4S1 according to A, figure 3-22. Adjust two other sections of switch so that flat sides of drive hole and reference notch in drive hole of each section match position of front section.

(10) Replace drive belt over two pulleys 1A3A4MP2 and 1A3A4MP1.

(11) Carefully insert tuner gear shaft 1A3A4A2MP4 through frame support No. 2 and logic switch.

(12) Replace three screws 1A3A4MP5H1 and

1A3A4MP5H2, flatwashers 1A3A4MP5H3, and one front support 1A3A4MP7.

(13) Reposition high voltage switch and section with four screws 1A3A4S2H1, flatwasher 1A3A4S2H2, four spacers (two 1A3A4MP19, one

1A3A4MP17, and one 1A3A4MP18), and one rear support 1A3A4MP8. Replace spacers 1A3A4MP22 noted during disassembly and secure with retaining ring 1A3A4MP25. Add or remove spacers to provide 0.002 to 0.005 inch shaft linear play.

(14) Adjust high voltage shaft 1A3A4MP3 and high voltage rotor 1A3A4S2MP1 until rotor is in position 1 and flat sides of high voltage shaft 1A3A4MP3 are parallel with vertical centerline through center of shaft.

(15) Adjust idler arm so that belt is taut, but do not tighten idler arm in place. While adjusting belt, high voltage shaft and rotor do not move.

(16) Carefully slip belt 1A3A4MP13 from pulley 1A3A4MP1. Do not allow pulley to turn on shaft as belt is removed. Drill new hole through pulley 1A3A4MP1 and shaft. Hole should be $0.062 + 0.004 - 0.001$ inch diameter. Pin pulley shaft together with spring pin 1A3A4MP16.

(17) Tighten belt with idler arm and secure idler arm. Ensure that high voltage shaft and switch are in position as required in (14) above.

(18) Replace motor drive assembly (s below).

p. Belt 1A3A4MP13.

(1) Perform the procedures in o(7) through (14) above.

(2) Adjust belt and idler arm 1A3A4MP21 (sheet 5) so that belt is taut and high voltage shaft 1A3A4MP3 and switch 1A3A4S1 are still properly positioned.

(3) Replace motor drive assembly (s below).

High Voltage Switch 1A3A4S2.

(1) Replace rotor 1A3A4S2MP1 (sheet 5) on high voltage shaft 1A3A4MP3.

(2) Reposition high voltage switch 1A3A4S2 and secure with four screws 1A3A4S2H1, flatwashers 1A3A4S2H2, spacers (two 1A3A4MP19, one 1A3A4MP18, and one 1A3A4MP17), and one rear support 1A3A4MP8.

(3) Replace spacers 1A3A4MP22 as noted during disassembly and secure with retaining ring 1A3A4MP25. Add or remove spacers to provide 0.002 to 0.005 inch shaft linear play.

(4) Adjust idler arm 1A3A4MP21 to tighten drive belt 1A3A4MP13.

(5) Tag and disconnect two wires from motor. Apply +15 vdc to motor to position tuner gear assembly shaft and logic switch as shown in E, figure 3-22.

(6) Adjust high voltage rotor 1A3A4S2MP1 until rotor is in position 1 and connects firmly with contact. Tighten setscrews. Verify that high voltage shaft flat sides are parallel with shaft vertical centerline. If they do not align properly, adjust belt to align shaft.

(7) With high voltage shaft 1A3A4MP3 and high voltage rotor 1A3A4S2MP1 in position as required in (6) above, slip belt from pulley 1A3A4MP1, and open hole in rotor through shaft to $0.062 + 0.004$ inch. Secure rotor to shaft with spring pin.

(8) Replace motor drive assembly (s below).

r. Servoamplifier 1A3A4A1.

(1) Reposition servoamplifier circuit card 1A3A4A1A1 (sheet 6) and solder tagged wires to correct connections.

(2) Reposition two spacers 1A3A4A1MP5 and install circuit card 1A3A4A1A1. Secure circuit card with two screws 1A3A4A1A1H1, one flatwasher 1A3A4A1A1H2, and one spacer 1A3A4A1MP3. Apply sealing and locking compound grade HV per MIL-S-22473 to screw threads before installation.

(3) Reinstall two spacers 1A3A4A1MP4 and servoamplifier cover 1A3A4A1MP1. Partially install two screws 1A3A4A1MP1H1 (sheet 5), lockwashers 1A3A4A1MP1H2, and flatwashers 1A3A4A1MP1H3 to hold spacers 1A3A4A1MP4 (sheet 6) in position when servoamplifier cover is replaced.

(4) Carefully slide servoamplifier under wires connected to coil 1L1 (sheet 2) and into position on motor drive assembly 1A3A4.

(5) Secure servoamplifier to motor drive assembly 1A3A4 by tightening two screws 1A3A4A1MP1H1 previously installed.

(6) Lower antenna coupler assembly 1A3 fully into housing.

(7) Perform the procedures in z(1) through (5), (8), and (9) below.

s. Motor Drive Assembly 1A3A4.

(1) Carefully position motor drive assembly 1A3A4 (sheet 2). Make sure coupline 1A3MP3 is properly engaged.

(2) Secure motor drive assembly 1A3A4 with four nuts 1A3A4H1 and lockwashers 1A3A4H2. Do not tighten nuts more than 30 inch-pounds.

(3) Tag and unsolder wires connected to terminals of drive motor 1A3A4B1 (sheet 5).

(4) Use a +15 vdc variable power supply to turn driver assembly cw until logic switch 1A3A4S1 is as shown in A, figure 3-22, the high voltage switch rotor 1A3A4MP1 is in position 1, and the teeth of driver assembly and tuner gear assembly just touch as shown in E, figure 3-22.

(5) Adjust coupling between drive gear of motor drive assembly 1A3A4 and variometer 1A3A2 (sheet 2) so that switch on variometer is as shown in H, figure 3-22.

(6) Apply sealing and locking compound grade HV per MIL-S-22473 to setscrew threads of coupling and tighten setscrews.

(7) Reconnect and solder tagged wires to terminals of drive motor.

(8) Reconnect and solder 13 wires to high voltage switch 1A3A4S1 (sheet 5).

(9) Replace switched filter 1A3A3 (v below).

t. Relays 1A3A3K1 and 1A3A3K2. The procedure to replace 1A3A3K1 is the same as for 1A3A3K2, below:

(1) Replace relay 1A3A3K1 (sheet 2) and secure

with two screws 1A3A3K1H1 and flatwashers 1A3A3K1H2.

(2) Reconnect and solder diode and wires connected to relay terminals. Make sure diode polarity is as noted during disassembly.

(3) Slide insulation sleeving on wires over relay terminals:

(4) Reinstall circuit card 1A3A3A1 (*u* below).

u. Circuit Card 1A3A3A1.

(1) Reconnect and solder four connections to 1S2 side of circuit card 1A3A3A1 (sheet 2).

(2) Place circuit card 1A3A3A1 against supports and secure with four screws 1A3A3A1H1 and lockwashers 1A3A3A1H2.

(3) Reconnect and solder one wire to switch 1S1 (sheet 3) as tagged.

(4) Replace switched filter 1A3A3 (*v* below).

v. Switched Filter 1A3A3.

(1) Hold switched filter 1A3A3 (sheet 2) near installation position and manually adjust rotary switch on circuit card until switch is aligned with flat side of drive shaft on motor drive assembly 1A3A4. Position of switch should correspond to numerical position of high voltage rotor 1A3A4S2MP1 (sheet 5).

(2) Slide switched filter 1A3A3 onto drive shaft and secure with four screws (three 1A3A3H1 and one 1A3A3H2).

(3) Install detector circuit card 1A3A1 (*y* below).

(4) Install antenna coupler 1A3 (*z* below).

w. Variometer Coils 1A3A2L1 and 1A3A2L4.

(1) Position new outer variometer coils 1A3A2L1 and 1A3A2L4 (1A3A2MP1, sheet 4, two places) against front plate assembly 1A3A2MP3. Feed two wires from one coil through front plate assembly 1A3A2MP3 as it is positioned.

(2) Secure outer variometer coils with three screws 1A3A2MP3H4, nuts 1A3A2MP3H1, lockwashers 1A3A2MP3H2, and flatwashers 1A3A2MP3H3.

(3) Cut, strip, and apply lug 1A3A2MP15 to outer variometer coil wire that protrudes through front plate assembly 1A3A2MP3 nearest the top of the front plate assembly. Ensure this wire, when prepared, is long enough to connect to spring contact 1A3A2MP10.

(4) Slide rear plate assembly 1A3A2MP4 over outer variometer coil wire that connects to outer spring contact 1A3A2MP10.

(5) Repeat step (3) for the outer variometer coil wire similarly located on the rear plate assembly 1A3A2MP4. Ensure this wire, when prepared, is long enough to connect to outer spring contact 1A3A2MP10.

(6) Perform the procedures in *x*(4) through (17) below.

x. Variometer Coils 1A3A2L2 and 1A3A2L3.

(1) Ensure front bushing 1A3A2MP5 (sheet 4) and rear bushing 1A3A2MP6 are in place in front plate assembly 1A3A2MP3 and rear plate assembly 1A3A2MP4, respectively.

(2) Carefully insert new inner coil 1A3A2MP2. Secure inner coil with washer 1A3A2MP7 and retaining clip 1A3A2MP8.

(3) Apply sealing and locking compound grade HV per MIL-S-22473 to threads of two screws 1A3A2MP10H1. Install spring contact 1A3A2MP10 and lug 1A3A2MP15 and secure with two screws prepared with compound and lockwashers to front plate assembly 1A3A2MP3. Adjust spring contact to exert 5 ± 0.5 grams.

(4) Slide variometer rear plate assembly 1A3A2MP4 over variometer inner coil shaft. Secure rear plate assembly with three screws 1A3A2MP4H4, nuts 1A3A2MP4H1, lockwashers 1A3A2MP4H2, and flatwashers 1A3A2MP4H3.

(5) Apply sealing and locking compound grade HV per MIL-S-22473 to threads of screw 1A3A2MP10H1. Install lug 1A3A2MP15 onto spring contact 1A3A2MP10 on rear plate assembly 1A3A2MP4 and secure with lockwasher 1A3A2MP10H2 and screw 1A3A2MP10H1 prepared with compound.

(6) Cut to length, strip, tin, connect, and solder remaining outer variometer coil wire to E2 on rear plate assembly 1A3A2MP4.

(7) Reposition 1A3A2MP18TB2 and secure with two screws 1A3A2MP18H4, nuts 1A3A2MP18H1, lockwashers 1A3A2MP18H2, and flatwashers 1A3A2MP18H3.

(8) Install two switch mounting screws 1A3A2S1H4. Align switch 1A3A2S1 and inner coil 1A3A2MP2 as shown in H and G, figure 3-22, respectively. Secure switch with two nuts 1A3A2S1H1, lockwashers 1A3A2S1H2, and flatwashers 1A3A2S1H3.

(9) Reinstall adapter 1A3A2MP13 over variometer shaft. Install setscrew, but do not tighten.

(10) Reposition coupling 1A3MP3 (sheet 2) over adapter 1A3A2MP13 (sheet 4). Apply sealing and locking compound grade HV per MIL-S-22473 to two coupling setscrews 1A3A2MP14. Install setscrew, but do not tighten.

(10) Reposition coupling 1A3MP3 (sheet 2) over adapter 1A3A2MP13 (sheet 4). Apply sealing and locking compound grade HV per MIL-S-22473 to two coupling setscrews 1A3A2MP14. Install setscrew but do not tighten.

(11) Install variometer and secure with four screws 1A3A2H2 (sheet 2), nuts 1A3A2H1, lockwashers 1A3A2H3, and flatwashers 1A3A2H4.

(12) Adjust adapter 1A3A2MP13 (sheet 4) and coupling 1A3MP3 (sheet 2) to align the reference line

drawn during disassembly and to properly mesh the coupling. Then tighten adapter setscrew and two coupling setscrews. If alignment is not certain, perform the procedures in s(3) through (7) above.

(13) Reconnect and solder wires connected to E3 (sheet 4) on front plate assembly 1A3A2MP3.

(14) Apply sealing and locking compound grade HV per MIL-S-22473 to screw 1A3A2MP9H1. Reconnect tagged wire to E1 on rear plate assembly 1A3A2MP4 and secure with screw prepared with compound and lockwasher 1A3A2MP9H2.

(15) Reconnect and solder wire to E2 of 1A3A2MP18TB2.

(16) Reinstall and secure 1A3A2P1 onto detector cover 1A3MP2 (sheet 2).

(17) Install antenna coupler 1A3 as instructed in z below.

y. Detector Circuit Card 1A3A1.

(1) Press detector circuit card 1A3A1 (sheet 2) against switched filter 1A3A3 and ensure that male plugs P1 and P2 mate with female jacks P1 and P2.

(2) Place four standoffs 1A3MP4 and detector cover 1A3MP2 in position and secure with four screws 1A3MP2H1, lockwashers 1A3MP2H3, and flatwashers 1A3MP2H2.

(3) Connect wire to E1 on detector circuit card 1A3A1.

(4) Install plug 1A3A2P1 (sheet 4) in retaining jacket on detector cover 1A3MP2 (sheet 2).

(5) Install antenna coupler 1A3 (z below).

z. Antenna Coupler 1A3.

(1) Place antenna coupler 1A3 (sheet 2) with attached tapped inductor 1L1 in position in transmitter.

(2) Apply silicone grease SM-A-726156-1 (Silicon Products G-300) to O-ring gasket of two screws 1L1H1 and 1L1H2 and apply grade HV locking compound per MIL-S-22473 to all screw threads.

(3) Install four screws 1A3H1 from above step and four washers 1A3H2 to secure antenna coupler 1A3 to transmitter. Torque screws to 4 inch-pounds.

(4) Install screw 1FL1H1 (sheet 3) and flatwasher 1FL1H3 to secure top of antenna coupler 1A3 and input line filter 1FL1.

(5) Install two screws 1L1H1 (sheet 2, ¼-inch long) and 1L1H2 (3/8-inch long) from (2), above, one spacer 1L1H4, plus two additional screws 1L1H3 and flatwasher 1L1H5 to secure tapped inductor 1L1 to transmitter.

(6) Solder wire to E1 of 1J4 (not shown).

(7) Connect plugs 1A1P2, 1W1P1, 1A2P2, 1P2, 1P3, and 1P5 (not shown).

(8) Place plate 1MP29 in position and secure with three screws 1MP29H1, lockwashers 1MP29H2, and flatwashers 1MP29H3.

(9) Install bottom cover 1A13 (sheet 1) and se-

cure with ten spring clamps.

aa. Rf Amplifier Circuit Card 1A2.

(1) Connect plugs 1A2P1, 1A2P2, and 1PS1P2 (not shown) and insert rf amplifier circuit card 1A2 (sheet 2) in position in transmitter.

(2) Apply silicone grease SM-A-726156-1 (Silicon Products G-300) to O-ring gaskets of 10 screws 1A2H1 and apply grade HV locking compound per MIL-S-22473 to screw threads.

(3) Secure rf amplifier circuit card 1A2 to side of transmitter case using screws from above step. Torque screws to 4 inch-pounds.

(4) Place rf shield assembly 1MP27 in position and secure with two screws 1MP27H1 and washers 1MP27H2.

(5) Install bottom cover 1A13 (sheet 1) into position and secure with ten spring clamps.

ab. Interconnect Circuit Card 1A1.

(1) Reposition circuit 1A1 (sheet 3) so that wires to be connected to underside of circuit card will reach terminal posts.

(2) Reconnect and solder tagged wires to terminals on underside of circuit card.

(3) Apply conformal coating to solder connections. Use type SR insulation compound per MIL-I-23053/5.

(4) Swing circuit card down into place and ensure that no wires are caught under card.

(5) Insert circuit card 1A8 into card holders. Position interconnect card connectors under 1A8 connectors and push 1A8 into position.

(6) Secure interconnect circuit card 1A1 with four flatwashers 1A1H2 and screws 1A1H1.

NOTE

Units produced before serial number suffix C do not utilize the circuit card retainer referred to in following step.

(7) Install circuit cards 1A4 through 1A11 and fasten retainer (m above).

ac. Bottom Cover 1A13.

(1) Place bottom cover 1A13 (sheet 1) in proper position.

(2) Connect and clamp ten spring clamps to secure cover to transmitter case.

(3) Close relief valve (RV) on front panel.

3-23. Amplifier Removal Procedures

The following instructions are for removal of assemblies, circuit cards, and component parts from the amplifier. See figure 3-23 for the locations of components.

WARNING

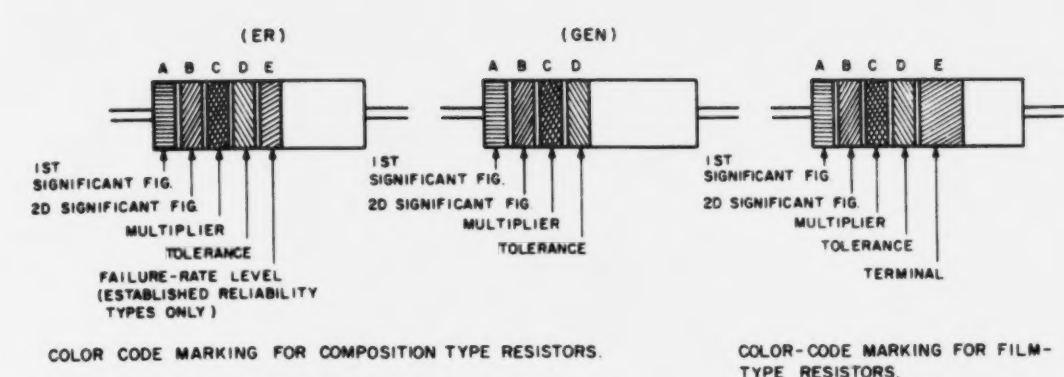
Turn OFF all power to the amplifier before any disassembly procedure is performed.

the desired component is removed:

- (1) Remove motor 3A1A1A2B1 (c below).
- (2) Remove hardware that secures two switches 3A1A1A2S1 (sheet 4) and 3A1A1A2S2 (hardware not shown). Remove two switches, actuator assem-

bly 3A1A1A2MP12, and doubler plate 3A1A1A2MP11.

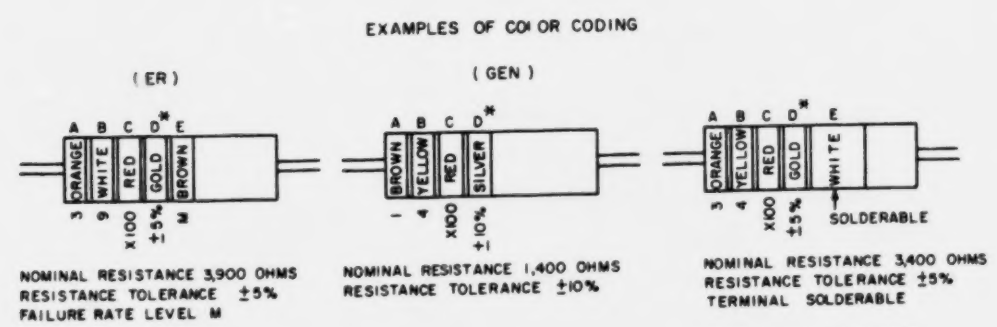
- (3) Remove four screws 3A1A1A2A2H1 and flat-



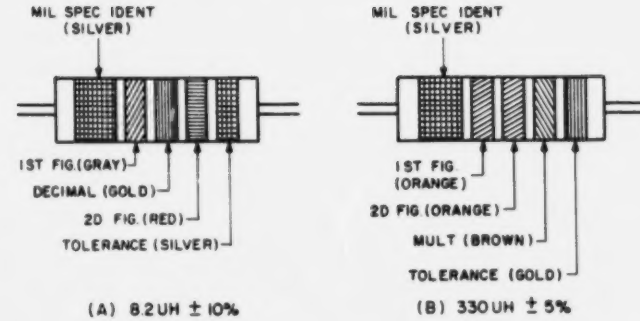
BAND A	BAND B	BAND C	BAND D	BAND E	TERM
COLOR	COLOR	COLOR	COLOR	COLOR	
BLACK	0	BLACK	0	BLACK	W1.0
BROWN	1	BROWN	1	BROWN	P1.0
RED	2	RED	2	RED	R1.0
ORANGE	3	ORANGE	3	ORANGE	Y1.0
YELLOW	4	YELLOW	4	YELLOW	W1.0
GREEN	5	GREEN	5	GREEN	10.0
BLUE	6	BLUE	6	BLUE	10.0
PURPLE	7	PURPLE	7	PURPLE	10.0
VIOLET	8	VIOLET	8	VIOLET	10.0
GRAY	9	GRAY	9	GRAY	10.0
WHITE	9	WHITE	9	WHITE	10.0

BAND A — THE FIRST SIGNIFICANT FIGURE OF THE RESISTANCE VALUE (BANDS A THRU D SHALL BE OF EQUAL WIDTH).
 BAND B — THE SECOND SIGNIFICANT FIGURE OF THE RESISTANCE VALUE.
 BAND C — THE MULTIPLIER (THE MULTIPLIER IS THE FACTOR BY WHICH THE TWO SIGNIFICANT FIGURES ARE MULTIPLIED TO YIELD THE NOMINAL RESISTANCE VALUE).
 BAND D — THE RESISTANCE TOLERANCE.
 BAND E — WHEN USED ON COMPOSITION RESISTORS, BAND E INDICATES ESTABLISHED RELIABILITY FAILURE-RATE LEVEL (PERCENT FAILURE PER 1,000 HOURS) ON FILM RESISTORS, THIS BAND SHALL BE APPROXIMATELY 1-1/2 TIMES THE WIDTH OF OTHER BANDS AND INDICATES TYPE OF TERMINAL RESISTANCES IDENTIFIED BY NUMBERS AND LETTERS (THESE ARE NOT COLOR CODES).
 SOME RESISTORS ARE IDENTIFIED BY THREE OR FOUR DIGIT ALPHA NUMERIC DESIGNATORS. THE LETTER R IS USED IN PLACE OF A DECIMAL POINT WHEN FRACTIONAL VALUES OF AN OHM ARE EXPRESSED. FOR EXAMPLE:
 247 ± 2% OHMS 10R0 ± 10% OHMS

FOR WIRE-WOUND TYPE RESISTORS COLOR CODING IS NOT USED. IDENTIFICATION MARKING IS SPECIFIED IN EACH OF THE APPLICABLE SPECIFICATIONS.



COMPOSITION-TYPE RESISTORS
 * IF BAND D IS OMITTED, THE RESISTOR TOLERANCE IS ± 20% AND THE RESISTOR IS NOT MIL-STD.
 A. COLOR CODE MARKING FOR MILITARY STANDARD RESISTORS



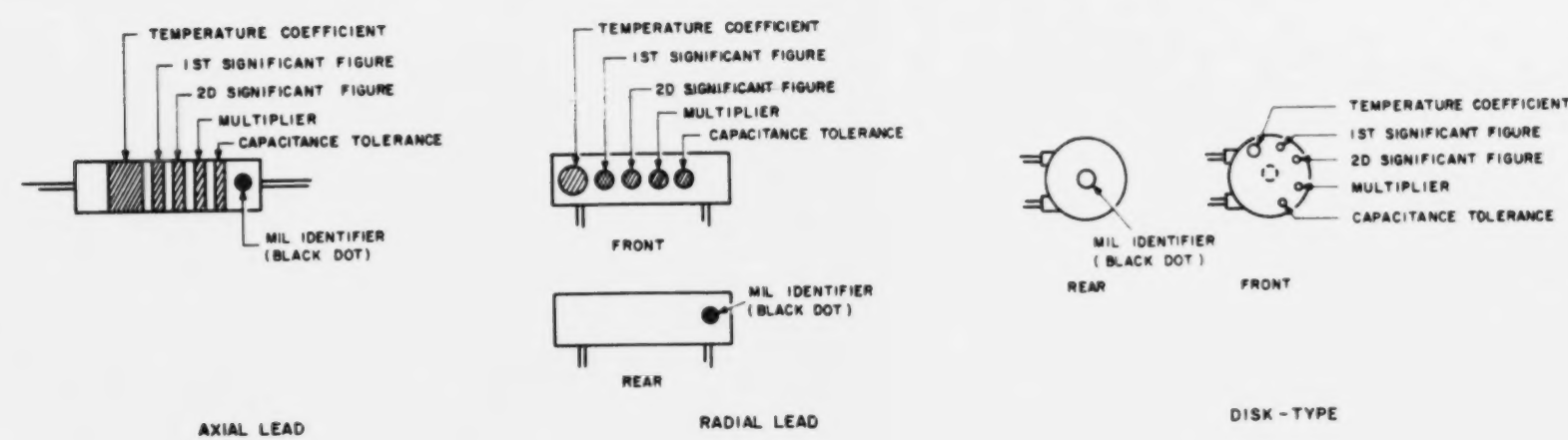
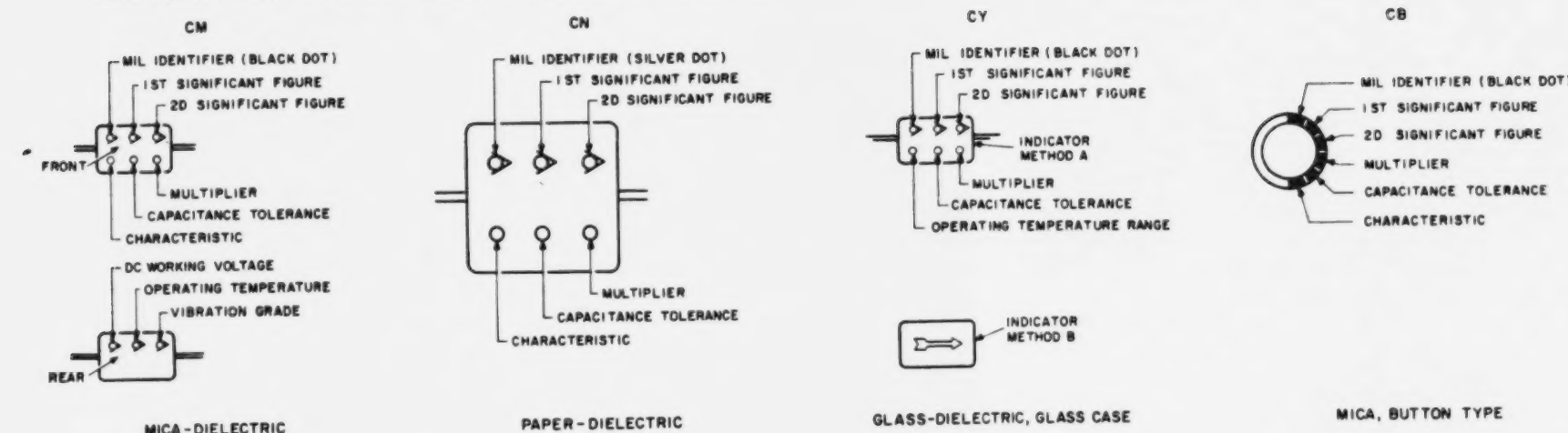
COLOR CODING FOR TUBULAR ENCAPSULATED R.F. CHOKES. AT A, AN EXAMPLE OF THE CODING FOR AN 8.2 uH CHOKES IS GIVEN. AT B, THE COLOR BANDS FOR A 330 uH INDUCTOR ARE ILLUSTRATED.

COLOR	SIGNIFICANT FIGURE	MULTIPLIER	INDUCTANCE TOLERANCE (PERCENT)
BLACK	0	1	1
BROWN	1	10	1
RED	2	100	2
ORANGE	3	1,000	3
YELLOW	4		
GREEN	5		
BLUE	6		
PURPLE	7		
VIOLET	8		
GRAY	9		
WHITE	9		
NONE		20	
SILVER		10	
GOLD		DECIMAL POINT	5

MULTIPLIER IS THE FACTOR BY WHICH THE TWO COLOR FIGURES ARE MULTIPLIED TO OBTAIN THE INDUCTANCE VALUE OF THE CHOKES COIL.

B. COLOR CODE MARKING FOR MILITARY STANDARD INDUCTORS.

CAPACITORS, FIXED, VARIOUS-DIELECTRICS, STYLES CM, CN, CY, AND CB



C. COLOR CODE MARKING FOR MILITARY STANDARD CAPACITORS

TABLE 3 — FOR USE WITH STYLES CM, CN, CY AND CB

COLOR	MIL ID	1ST SIG FIG	2ND SIG FIG	MULTIPLIER	CAPACITANCE TOLERANCE	CHARACTERISTIC	DC WORKING VOLTAGE	OPERATING RANGE	VIBRATION GRADE
BLACK	0	0	0	1	200%	200%	A	E	B
BROWN	1	1	1	10	20%	20%	B	E	B
RED	2	2	2	100	10%	10%	C	D	300
ORANGE	3	3	3	1,000	10%	10%	D	D	300
YELLOW	4	4	4	10,000	10%	10%	E	D	300
GREEN	5	5	5	100,000	10%	10%	F	D	300
BLUE	6	6	6	1,000,000	10%	10%	G	D	300
PURPLE	7	7	7	10,000,000	10%	10%	H	D	300
GRAY	8	8	8	100,000,000	10%	10%	I	D	300
WHITE	9	9	9	1,000,000,000	10%	10%	J	D	300
GOLD				0.1	10%	10%	K	D	300
SILVER				0.01	10%	10%	L	D	300

TABLE 4 — TEMPERATURE COMPENSATING, STYLE CC

COLOR	TEMPERATURE COEFFICIENT	1ST SIG FIG	2ND SIG FIG	MULTIPLIER	CAPACITANCE TOLERANCE	CHARACTERISTIC
BLACK	0	0	0	1	200%	200%
BROWN	-30	1	1	10	20%	20%
RED	-80	2	2	100	10%	10%
ORANGE	-150	3	3	1,000	10%	10%
YELLOW	-220	4	4	10,000	10%	10%
GREEN	-330	5	5	100,000	10%	10%
BLUE	-470	6	6	1,000,000	10%	10%
PURPLE	-750	7	7	10,000,000	10%	10%
VIOLET	-1000	8	8	100,000,000	10%	10%
GRAY	-1500	9	9	1,000,000,000	10%	10%
WHITE	+100			0.1	10%	10%
GOLD				0.01	10%	10%
SILVER				0.001	10%	10%

- THE MULTIPLIER IS THE NUMBER BY WHICH THE TWO SIGNIFICANT (SIG) FIGURES ARE MULTIPLIED TO OBTAIN THE CAPACITANCE IN UUF.
- LETTERS INDICATE THE CHARACTERISTICS DESIGNATED IN APPLICABLE SPECIFICATIONS. MIL-C-250, MIL-C-250, MIL-C-12728, AND MIL-C-10950C RESPECTIVELY.
- LETTERS INDICATE THE TEMPERATURE RANGE AND VOLTAGE-TEMPERATURE LIMITS DESIGNATED IN MIL-C-11015D.
- TEMPERATURE COEFFICIENT IN PARTS PER MILLION PER DEGREE CENTIGRADE.
- OPTIONAL CODING WHERE METALLIC PIGMENTS ARE UNDESIRABLE.

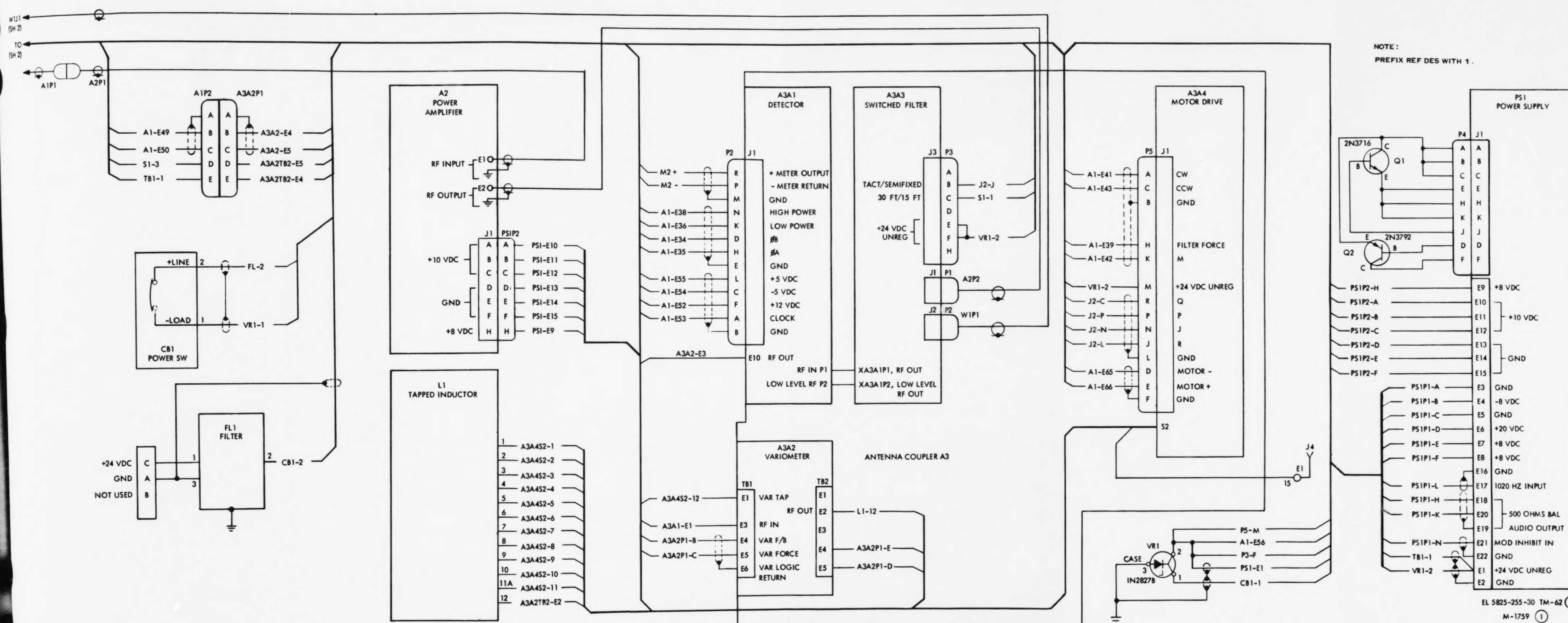


Figure PO-2. Transmitter, Interconnect, Diagram (sheet 1 of 2).

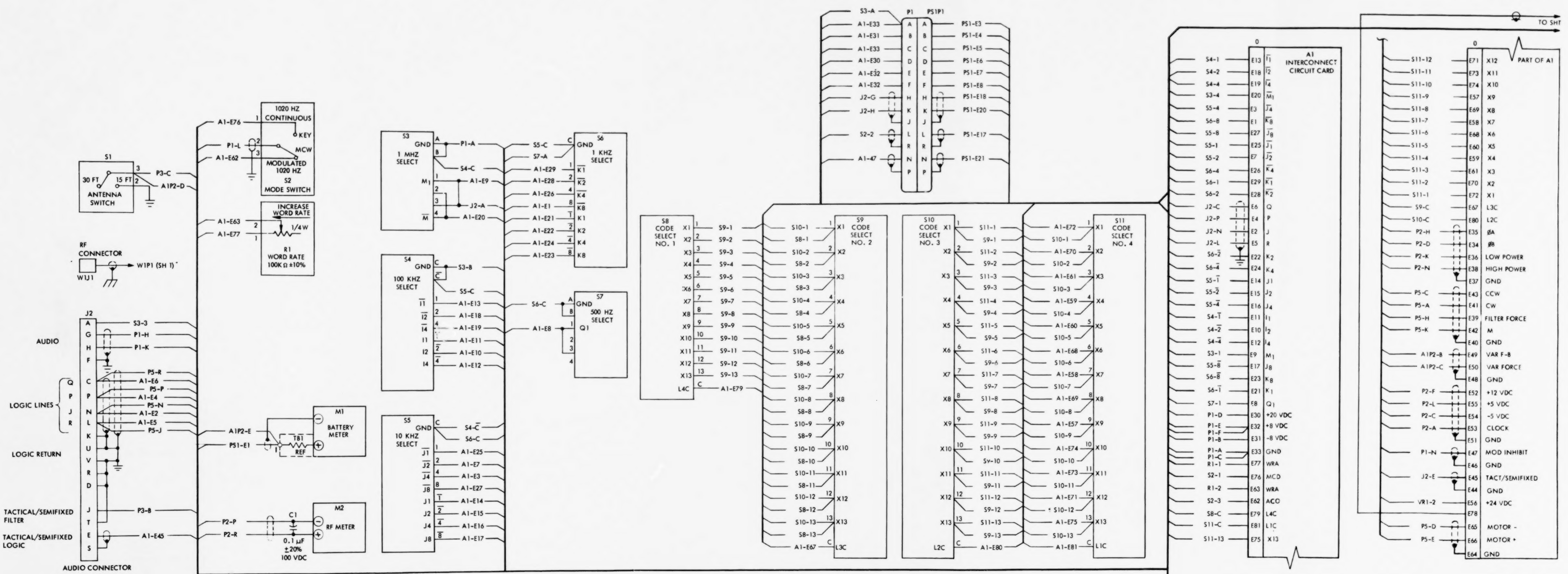
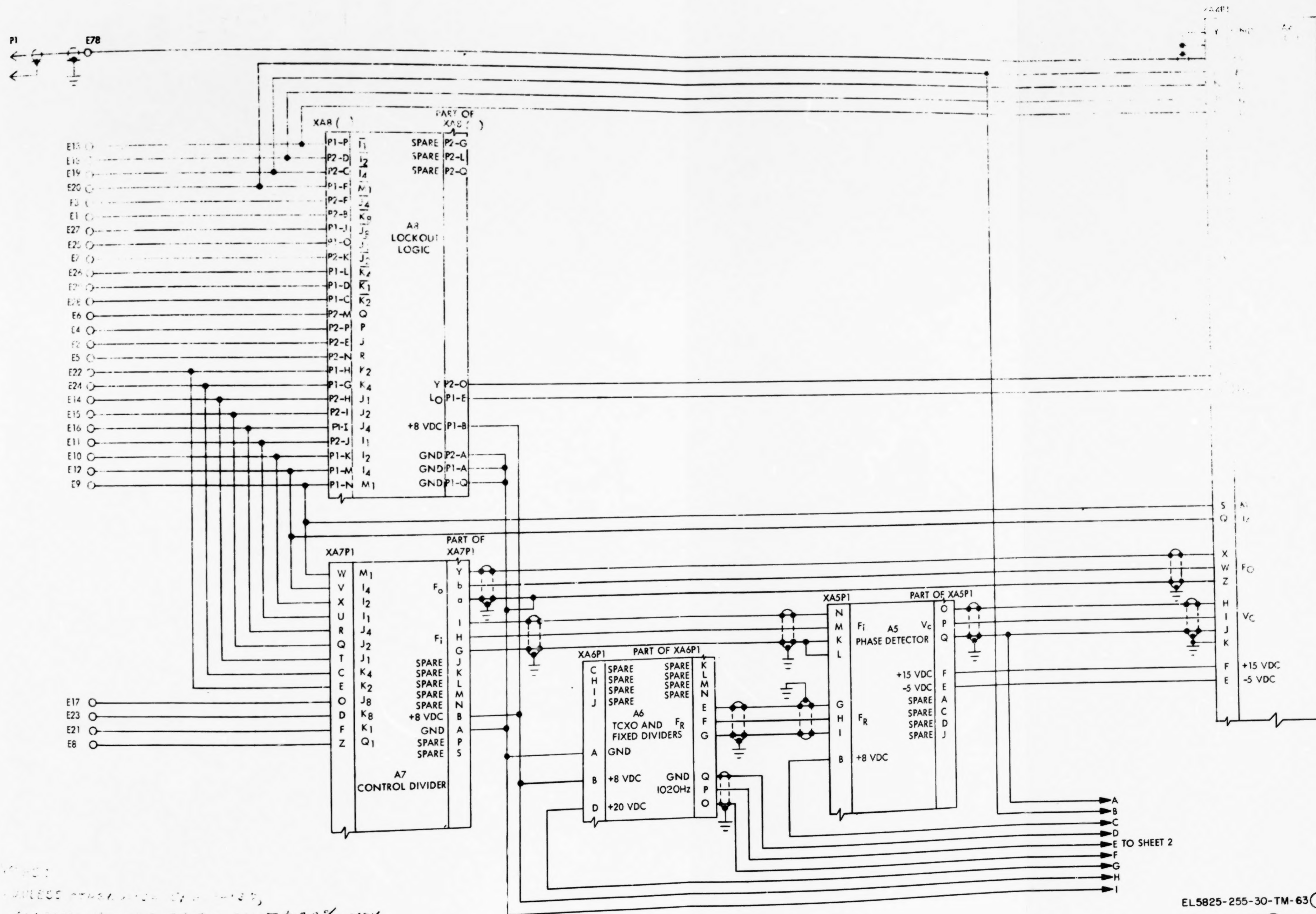


Figure FO-2. Transmitter Interconnect Diagram (sheet 2 of 2).



UNLESS OTHERWISE SPECIFIED,
ALL VALUES ARE 0.01UF, ±20%, 100V.
ALL COMPONENT DESIGNATIONS WITH 1.

EL5825-255-30-TM-63 (1)
M-1760 (1)

Figure FO-3. Transmitter Interconnect Circuit card 1A1, Schematic Diagram (sheet 1 of 2).

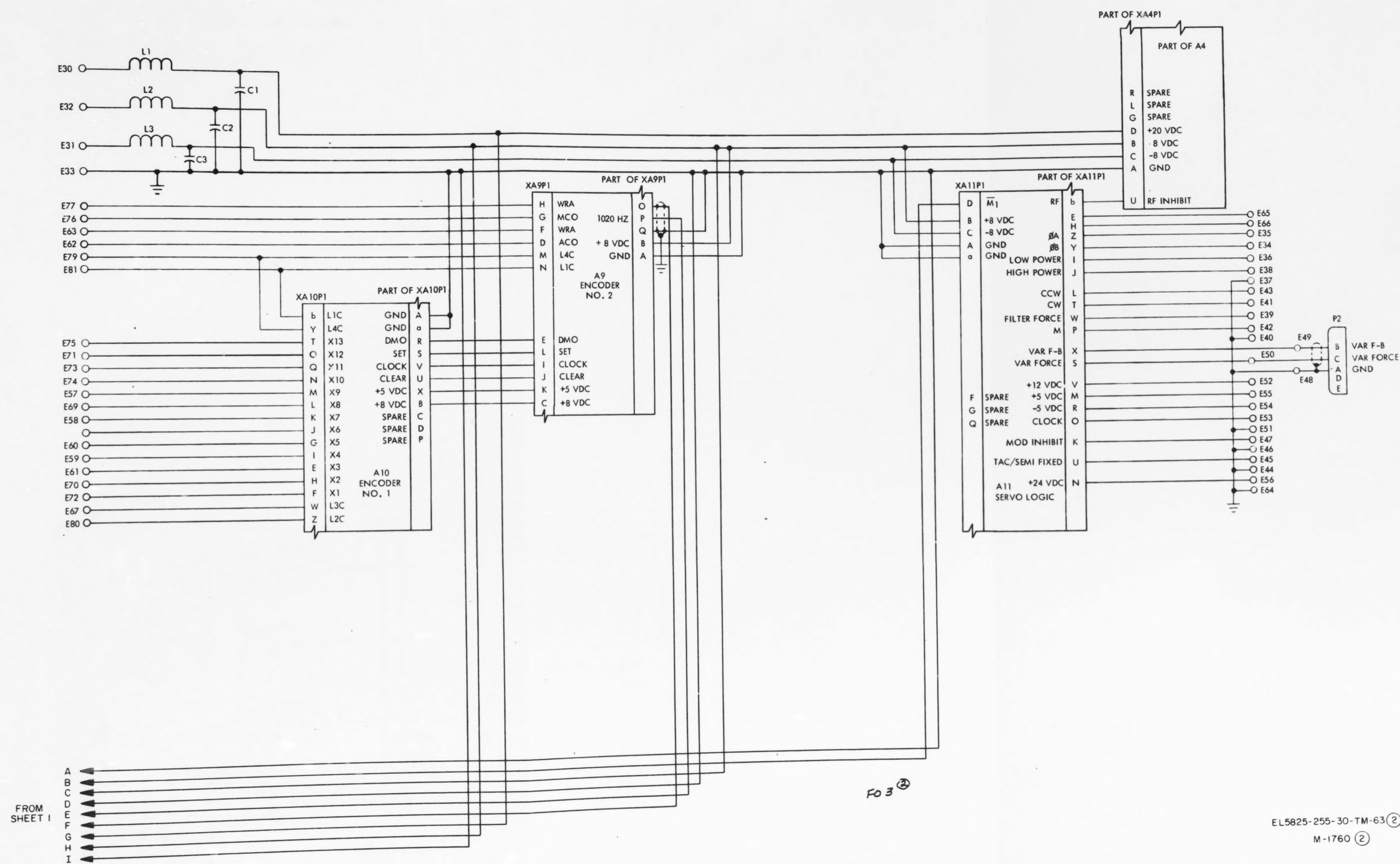


Figure FO-3. Transmitter Interconnect Circuit Card 1A1, Schematic Diagram (sheet 2 of 2).

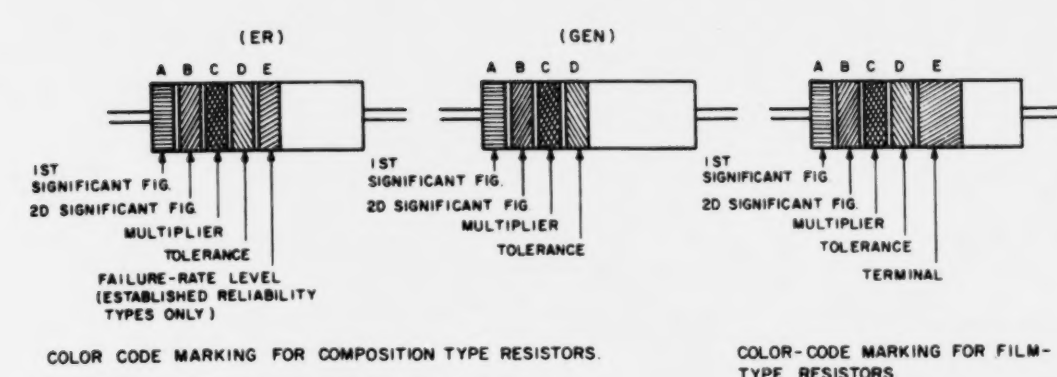


TABLE 1
COLOR CODE FOR COMPOSITION TYPE AND FILM TYPE RESISTORS

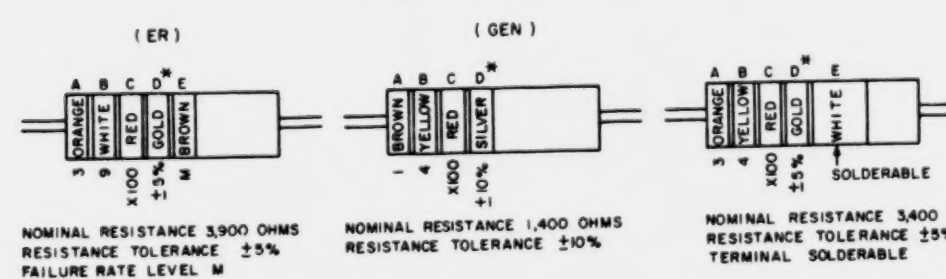
BAND A		BAND B		BAND C		BAND D		BAND E	
COLOR	FIRST SIGNIFICANT FIGURE	COLOR	SECOND SIGNIFICANT FIGURE	COLOR	MULTIPLIER	COLOR	RESISTANCE TOLERANCE (PERCENT)	COLOR	FAILURE RATE LEVEL
BLACK	0	BLACK	0	BLACK	1	BROWN	±1.0	BROWN	M+1.0
BROWN	1	BROWN	1	BROWN	10	RED	±0.1	RED	P+0.1
RED	2	RED	2	RED	100	ORANGE	±0.01	ORANGE	R+0.01
ORANGE	3	ORANGE	3	ORANGE	1,000	YELLOW	±0.001	YELLOW	S+0.001
YELLOW	4	YELLOW	4	YELLOW	10,000	SILVER	±10 (COMP. TYPE ONLY)	WHITE	WHITE
GREEN	5	GREEN	5	GREEN	100,000	GOLD	±5		
BLUE	6	BLUE	6	BLUE	1,000,000	RED	±2.5 (NOT APPLICABLE TO ESTABLISHED RELIABILITY)		
PURPLE (VIOLET)	7	PURPLE (VIOLET)	7						
GRAY	8	GRAY	8	SILVER	0.01				
WHITE	9	WHITE	9	GOLD	0.1				

BAND A — THE FIRST SIGNIFICANT FIGURE OF THE RESISTANCE VALUE (BANDS A THRU D SHALL BE OF EQUAL WIDTH).
 BAND B — THE SECOND SIGNIFICANT FIGURE OF THE RESISTANCE VALUE.
 BAND C — THE MULTIPLIER (THE MULTIPLIER IS THE FACTOR BY WHICH THE TWO SIGNIFICANT FIGURES ARE MULTIPLIED TO YIELD THE NOMINAL RESISTANCE VALUE).
 BAND D — THE RESISTANCE TOLERANCE.
 BAND E — WHEN USED ON COMPOSITION RESISTORS, BAND E INDICATES ESTABLISHED RELIABILITY FAILURE-RATE LEVEL PERCENT FAILURE PER 1,000 HOURS ON FILM RESISTORS, THIS BAND SHALL BE APPROXIMATELY 1-1/2 TIMES THE WIDTH OF OTHER BANDS AND INDICATES TYPE OF TERMINAL (THESE ARE NOT COLOR CODED).

SOME RESISTORS ARE IDENTIFIED BY THREE OR FOUR DIGIT ALPHA NUMERIC DESIGNATORS. THE LETTER H IS USED IN PLACE OF A DECIMAL POINT WHEN FRACTIONAL VALUES OF OHMS ARE EXPRESSED. FOR EXAMPLE:
 287 = 2.7 OHMS 1000 = 10.0 OHMS

FOR WIRE-WOUND-TYPE RESISTORS COLOR CODING IS NOT USED, IDENTIFICATION MARKING IS SPECIFIED IN EACH OF THE APPLICABLE SPECIFICATIONS.

EXAMPLES OF COLOR CODING



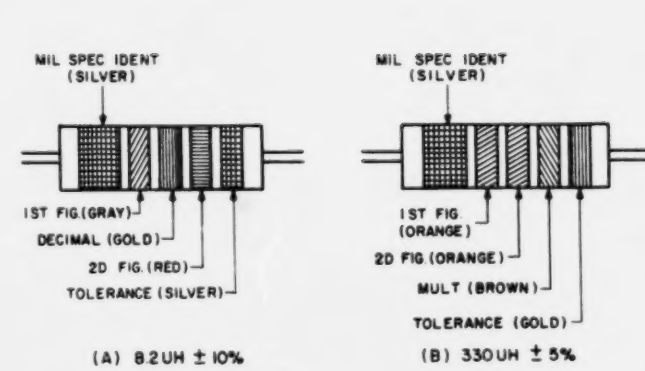
NOMINAL RESISTANCE 3900 OHMS
 RESISTANCE TOLERANCE ±5%
 FAILURE RATE LEVEL M

NOMINAL RESISTANCE 1400 OHMS
 RESISTANCE TOLERANCE ±10%
 TERMINAL SOLDERABLE

NOMINAL RESISTANCE 3400 OHMS
 RESISTANCE TOLERANCE ±5%
 TERMINAL SOLDERABLE

COMPOSITION-TYPE RESISTORS

IF BAND D IS OMITTED, THE RESISTOR TOLERANCE IS ±20% AND THE RESISTOR IS NOT MIL-STD.
 A. COLOR CODE MARKING FOR MILITARY STANDARD RESISTORS



COLOR CODING FOR TUBULAR ENCAPSULATED RF CHOKES. AT A, AN EXAMPLE OF THE CODING FOR AN 8.2UH CHOKES IS GIVEN. AT B, THE COLOR BANDS FOR A 330UH INDUCTOR ARE ILLUSTRATED.

TABLE 2
COLOR CODING FOR TUBULAR ENCAPSULATED RF CHOKES

COLOR	SIGNIFICANT FIGURE	MULTIPLIER	INDUCTANCE TOLERANCE (PERCENT)
BLACK	0	1	
BROWN	1	10	±1
RED	2	100	±2
ORANGE	3	1,000	±3
YELLOW	4		
GREEN	5		
BLUE	6		
VIOLET	7		
GRAY	8		
WHITE	9		
NONE		20	
SILVER		10	
GOLD		DECIMAL POINT	5

MULTIPLIER IS THE FACTOR BY WHICH THE TWO COLOR FIGURES ARE MULTIPLIED TO OBTAIN THE INDUCTANCE VALUE OF THE CHOKES COIL.

B. COLOR CODE MARKING FOR MILITARY STANDARD INDUCTORS.

CAPACITORS, FIXED, VARIOUS-DIELECTRICS, STYLES CM, CN, CY, AND CB

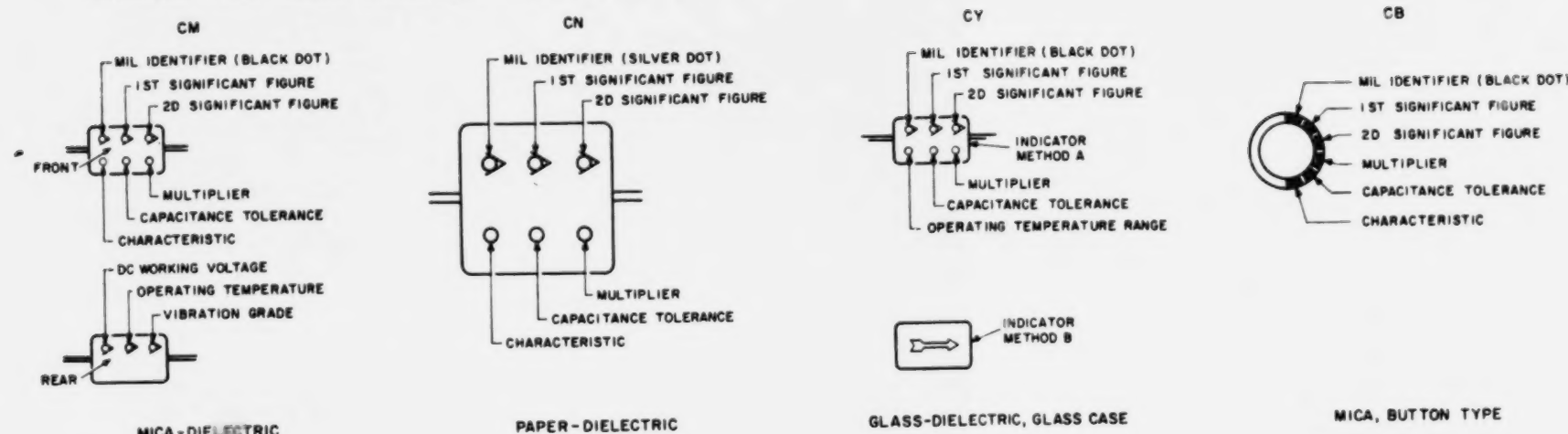


TABLE 3 — FOR USE WITH STYLES CM, CN, CY AND CB

COLOR	MIL D	1ST SIG FIG	2D SIG FIG	MULTIPLIER	CAPACITANCE TOLERANCE				CHARACTERISTIC	DC VOLTAGE	OPERATING TEMPERATURE RANGE	VIBRATION GRADE
					CM	CN	CY	CB				
BLACK	0	0	0	1	20%	10%	5%	1%	A	50V	-55°C to +125°C	K-55-H
BROWN	1	1	1	10	20%	10%	5%	1%	B	50V	-55°C to +125°C	K-55-H
RED	2	2	2	100	20%	10%	5%	1%	C	50V	-55°C to +125°C	K-55-H
ORANGE	3	3	3	1,000	20%	10%	5%	1%	D	50V	-55°C to +125°C	K-55-H
YELLOW	4	4	4	10,000	20%	10%	5%	1%	E	50V	-55°C to +125°C	K-55-H
GREEN	5	5	5	55%					F	50V	-55°C to +125°C	K-55-H
BLUE	6	6	6									
PURPLE (VIOLET)	7	7	7									
GRAY	8	8	8									
WHITE	9	9	9									
GOLD				0.1	±10%	±10%	±10%	±10%				
SILVER	CN			0.01	±10%	±10%	±10%	±10%				

TABLE 4 — TEMPERATURE COMPENSATING, STYLE CC

COLOR	TEMPERATURE COEFFICIENT	1ST SIG FIG	2D SIG FIG	MULTIPLIER	CAPACITANCE TOLERANCE		MIL D
					CAPACITANCE OVER 10 UUF	CAPACITANCE 10 UUF OR LESS	
BLACK	0	0	0	1	±1%	±2.0 UUF	CC
BROWN	-30	1	1	10	±1%		
RED	-80	2	2	100	±2%	±0.25 UUF	
ORANGE	-150	3	3	1,000			
YELLOW	-220	4	4				
GREEN	-330	5	5		±5%	±0.5 UUF	
BLUE	-470	6	6				
PURPLE (VIOLET)	-750	7	7				
GRAY		8	8	0.01*			
WHITE		9	9	0.1*	±10%		
GOLD	+100			0.1		±1.0 UUF	
SILVER				0.01			

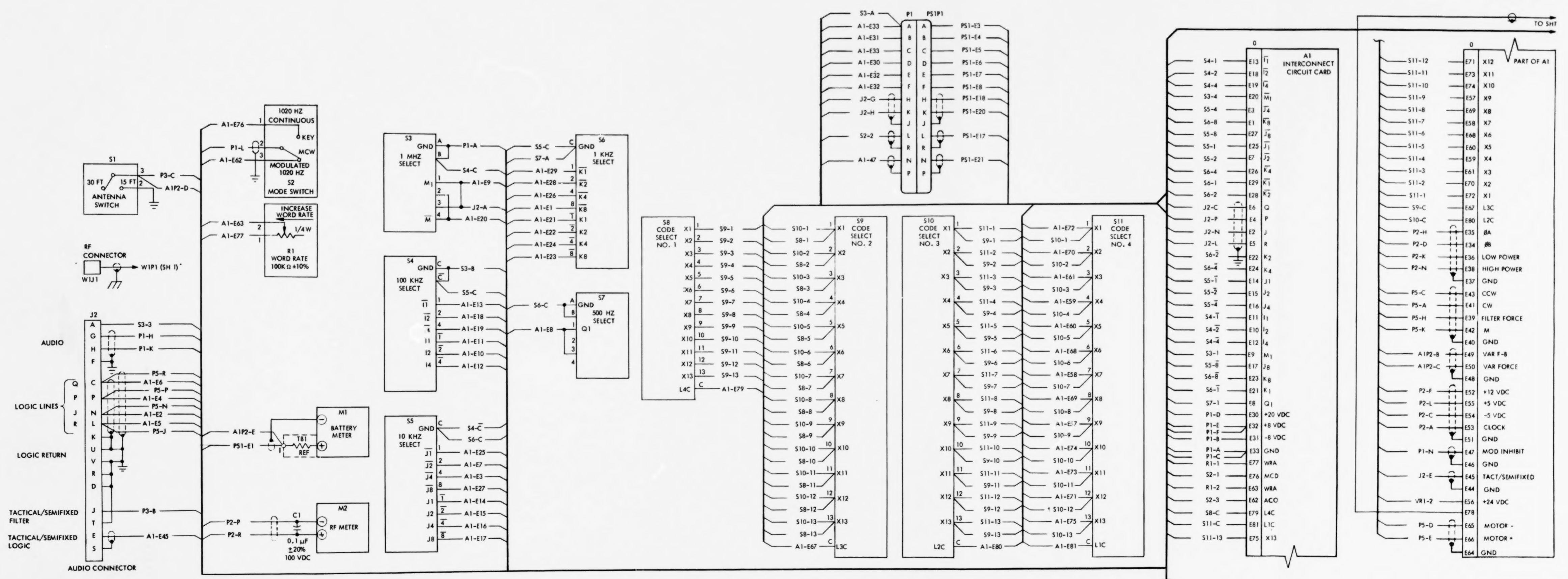
- THE MULTIPLIER IS THE NUMBER BY WHICH THE TWO SIGNIFICANT (SIG) FIGURES ARE MULTIPLIED TO OBTAIN THE CAPACITANCE IN UUF.
- LETTERS INDICATE THE CHARACTERISTICS DESIGNATED IN APPLICABLE SPECIFICATIONS. MIL-C-5, MIL-C-250, MIL-C-12720, AND MIL-C-10950C RESPECTIVELY.
- LETTERS INDICATE THE TEMPERATURE RANGE AND VOLTAGE-TEMPERATURE LIMITS DESIGNATED IN MIL-C-11015D.
- TEMPERATURE COEFFICIENT IN PARTS PER MILLION PER DEGREE CENTIGRADE.
- OPTIONAL CODING WHERE METALLIC PIGMENTS ARE UNDESIRABLE.

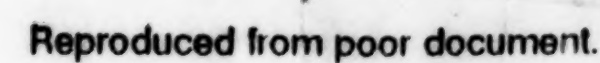
C. COLOR CODE MARKING FOR MILITARY STANDARD CAPACITORS

Figure PO-1. MIL-STD Resistors, Inductors, and Capacitors Color Code Markings.

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Figure FO-2. Transmitter, Interconnect, Diagram (sheet 1 of 2).





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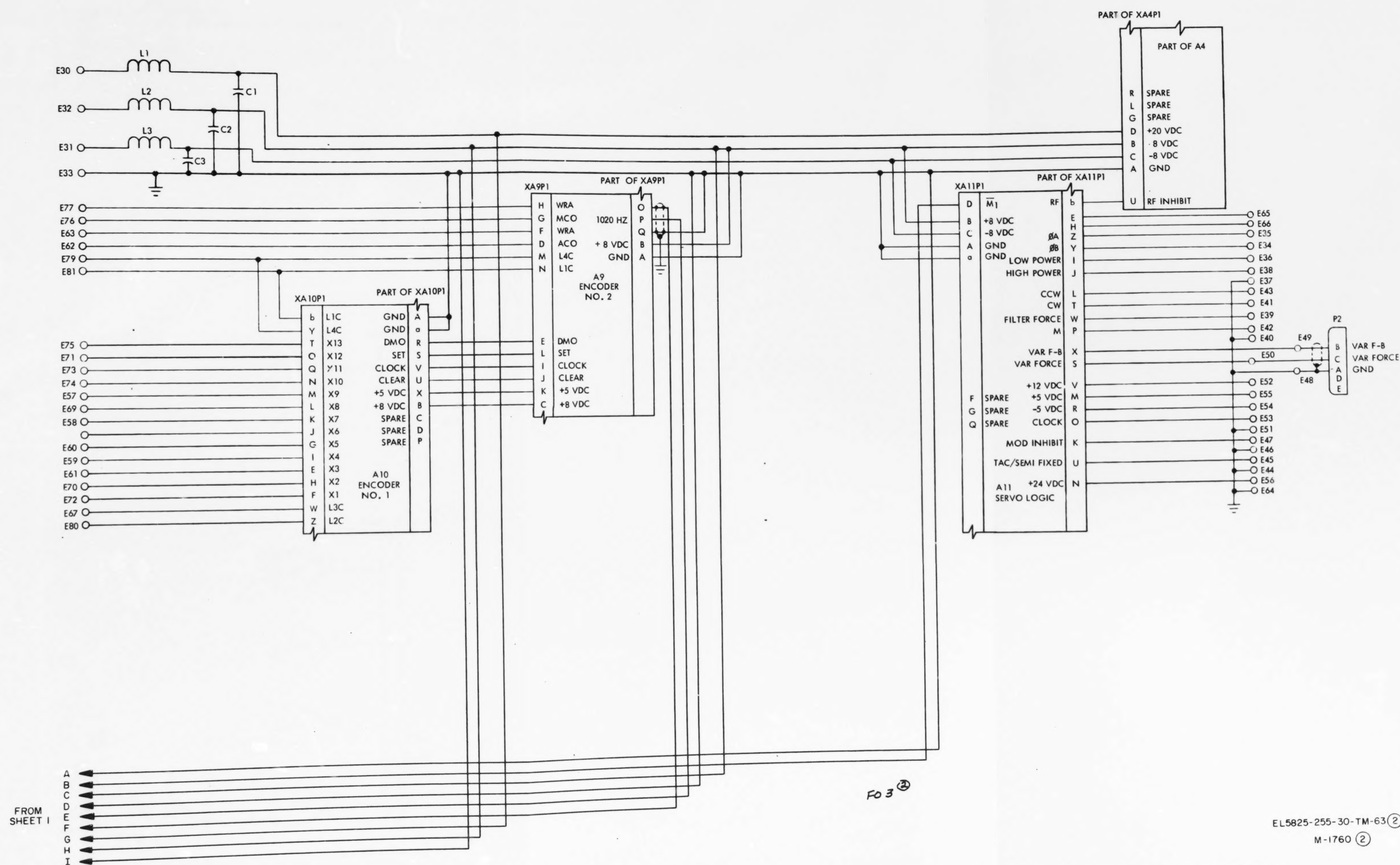


Figure FO-3. Transmitter Interconnect Circuit Card 1A1, Schematic Diagram (sheet 2 of 2).

NOTES:

1. UNLESS OTHERWISE SPECIFIED, RESISTANCE VALUES ARE IN OHMS, 4.7K, 45K, 1/8W.
2. PREFIX REF DES WITH AB.
3. PIN 7 OF U1 THRU U13 ARE CONNECTED TO GND.
4. PIN 14 OF U1 THRU U13 ARE CONNECTED TO VCC.
5. PINS G, L AND Q OF P2 ARE NOT USED.
6. DESIGNATIONS INDICATE CONNECTIONS AT INTERCONNECT ASSY: XASPI OR XASPI2, FIG. FO-3.

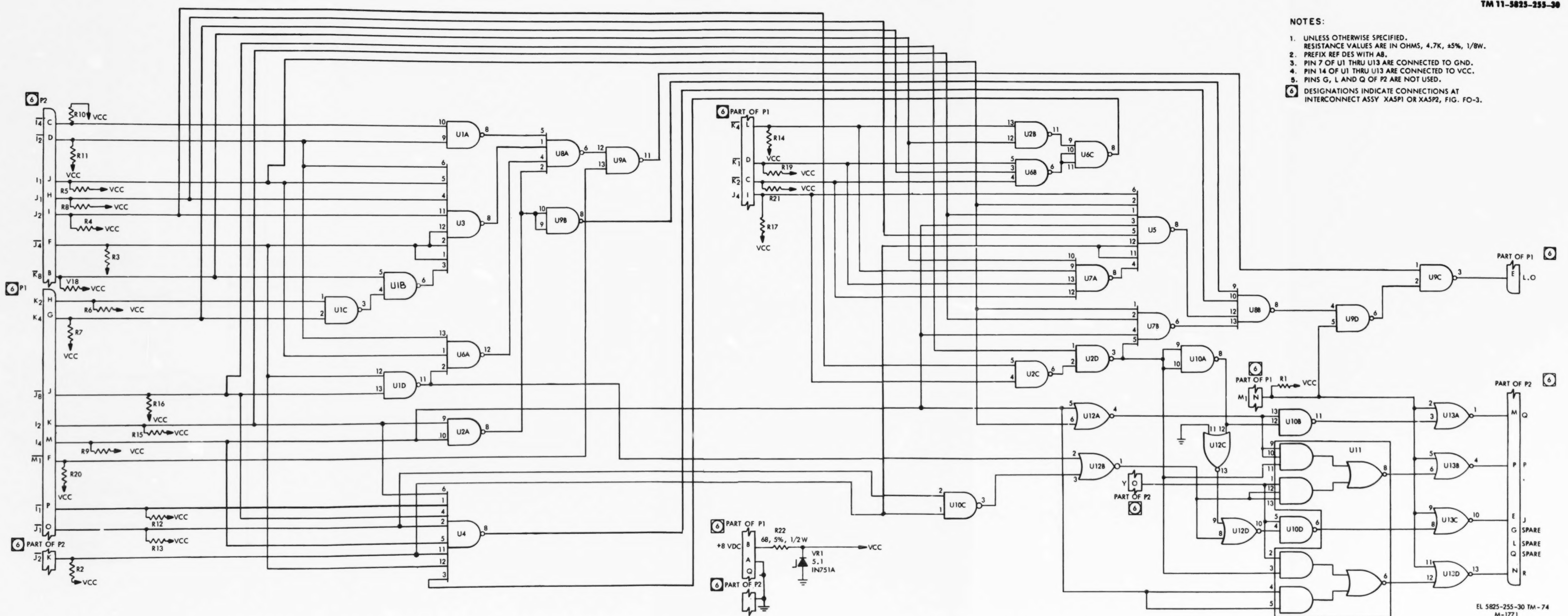
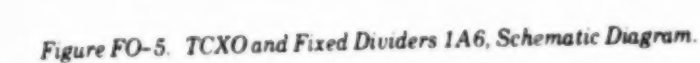
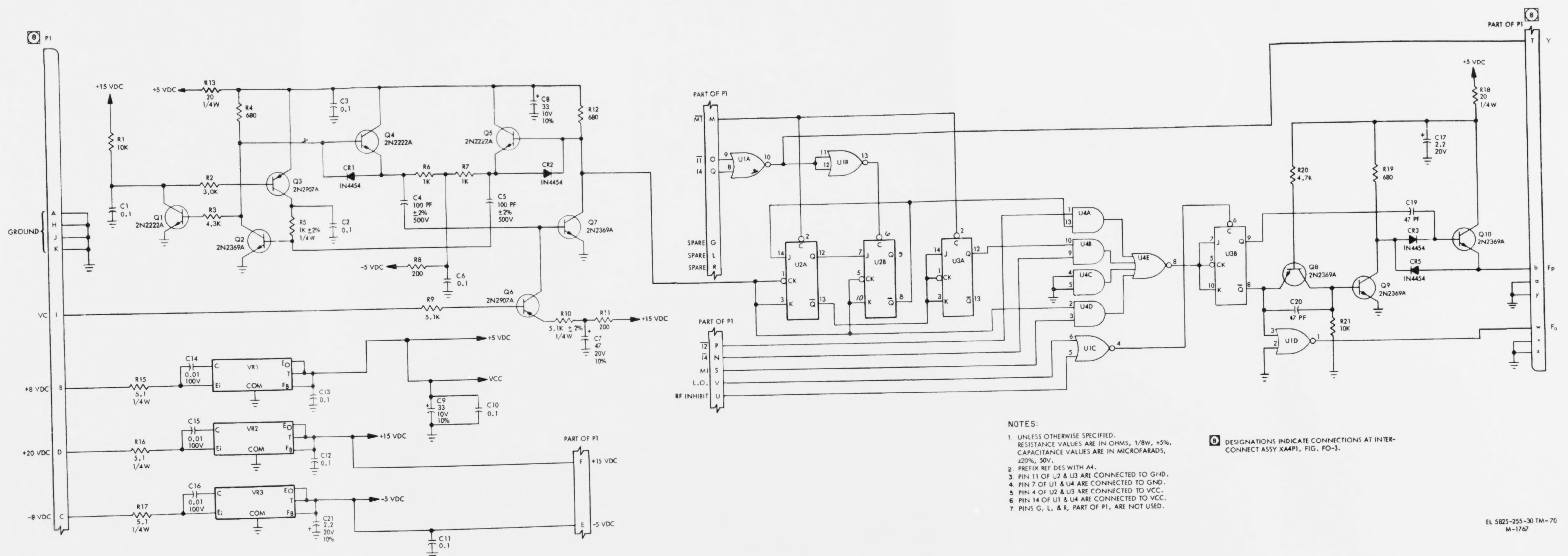


Figure FO-4. Lockout Logic 1A8, Schematic Diagram.

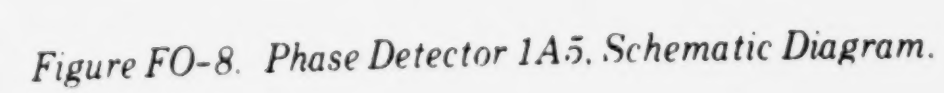




- NOTES:
1. UNLESS OTHERWISE SPECIFIED, RESISTANCE VALUES ARE IN OHMS, 1/8W, ±5%. CAPACITANCE VALUES ARE IN MICROFARADS, ±20%, 50V.
 2. PREFIX REF DES WITH A4.
 3. PIN 11 OF U2 & U3 ARE CONNECTED TO GND.
 4. PIN 7 OF U1 & U4 ARE CONNECTED TO VCC.
 5. PIN 4 OF U2 & U3 ARE CONNECTED TO VCC.
 6. PIN 14 OF U1 & U4 ARE CONNECTED TO VCC.
 7. PINS G, L, & R, PART OF P1, ARE NOT USED.

DESIGNATIONS INDICATE CONNECTIONS AT INTER-CONNECT ASSY XA4P1, FIG. FO-3.

Figure FO-6. VCO 1A4. Schematic Diagram.



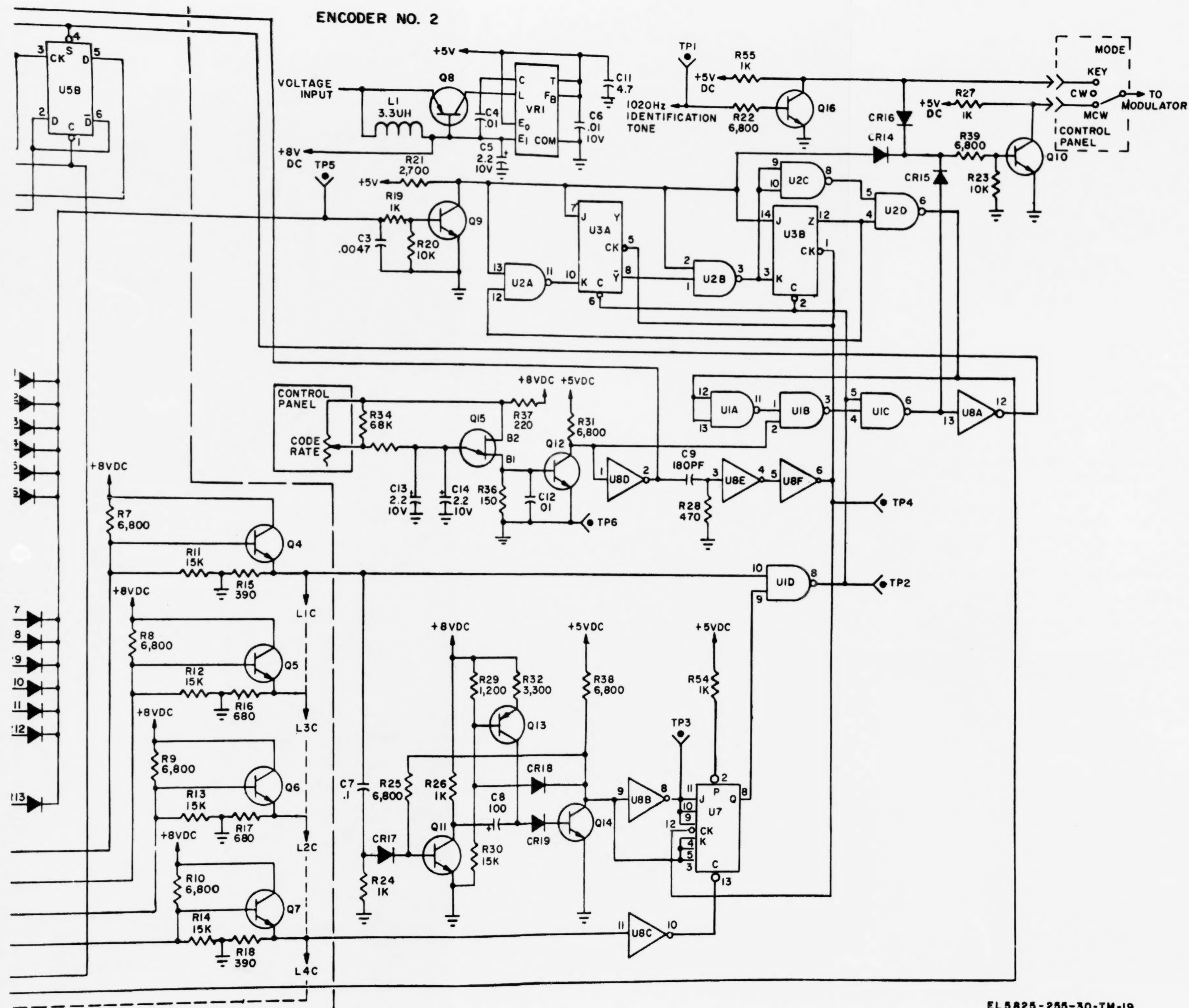
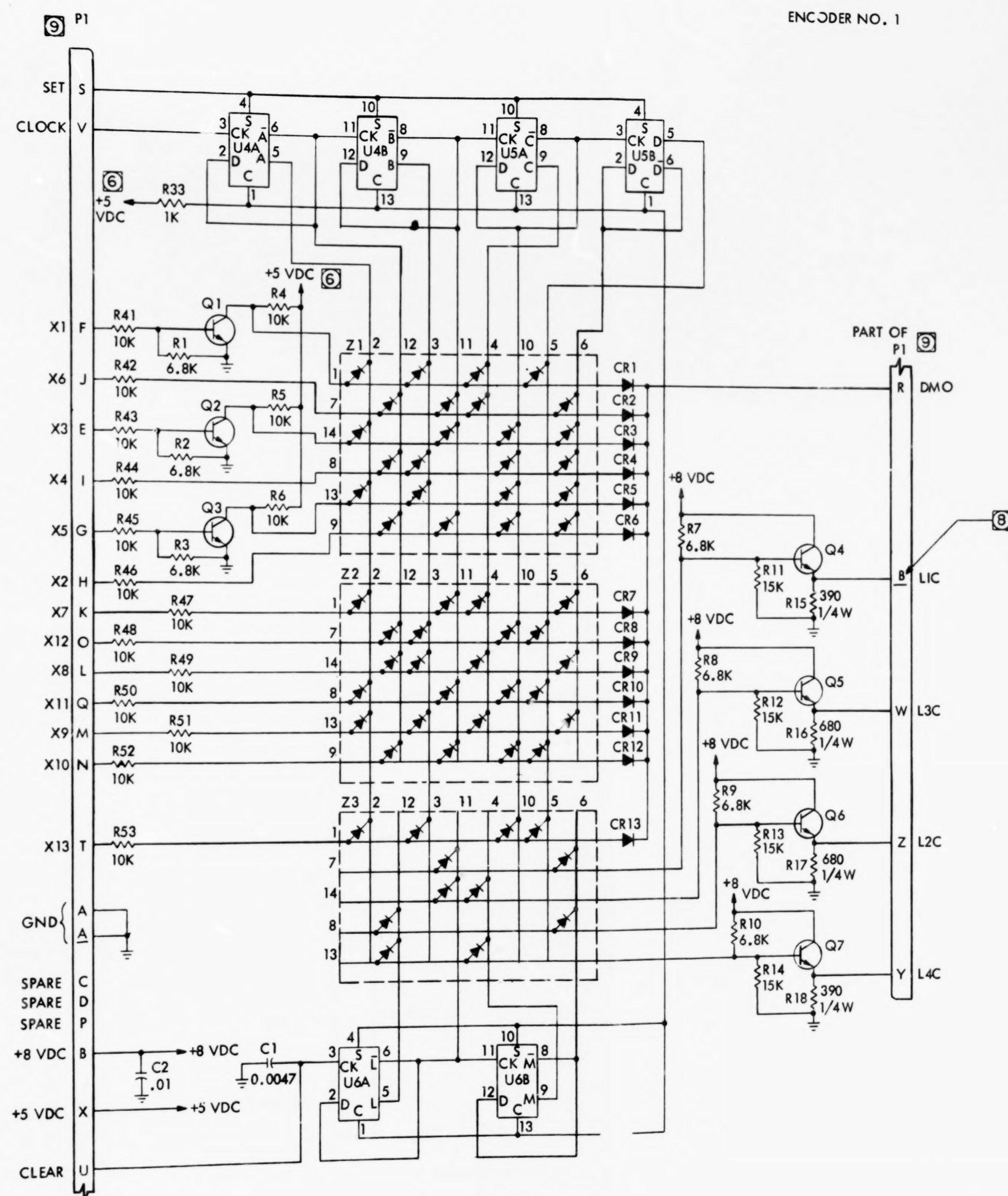


Figure FO-9. Encoder. Functional Schematic Diagram.



NOTES:

1. UNLESS OTHERWISE SPECIFIED.
RESISTANCE VALUES ARE IN OHMS, $\pm 5\%$, 1/8W.
CAPACITANCE VALUES ARE IN MICROFARADS,
 $\pm 10\%$, 100V.
2. PREFIX REF DES WITH A10.
3. Q1 THRU Q7 TRANSISTORS ARE 2N2222A.
4. CR1 THRU CR13 DIODES ARE 1N4454.
5. PINS NOT USED: C, D, & P.
6. +5 VDC IS CONNECTED TO PIN 14 OF U4, U5 & U8.
7. GROUND IS CONNECTED TO PIN 7 OF U4, U5 & U6.
8. LOWER CASE LETTERS ARE SHOWN AS UPPER CASE
AND UNDERLINED FOR CLARITY.
9. DESIGNATIONS INDICATE CONNECTIONS AT
INTERCONNECT ASSY XA7P1, FIG. FO-3.

Figure FO-10. Encoder No. 1 1A10, Schematic Diagram.

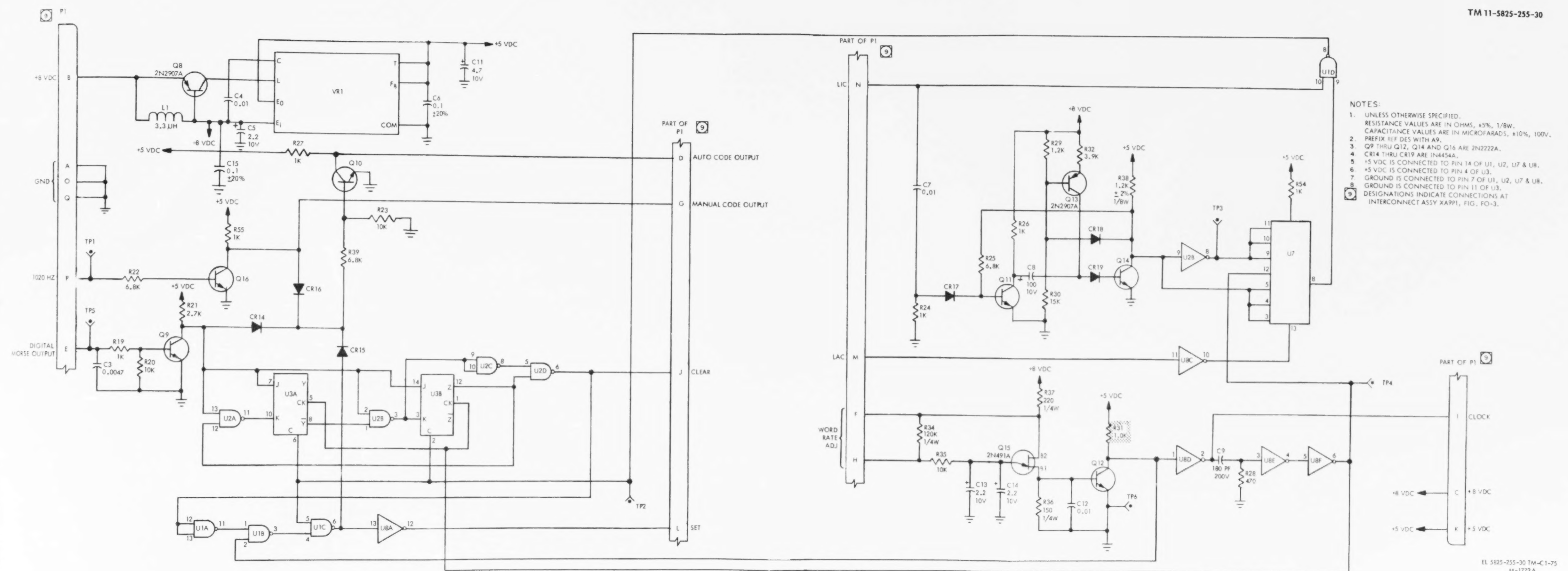
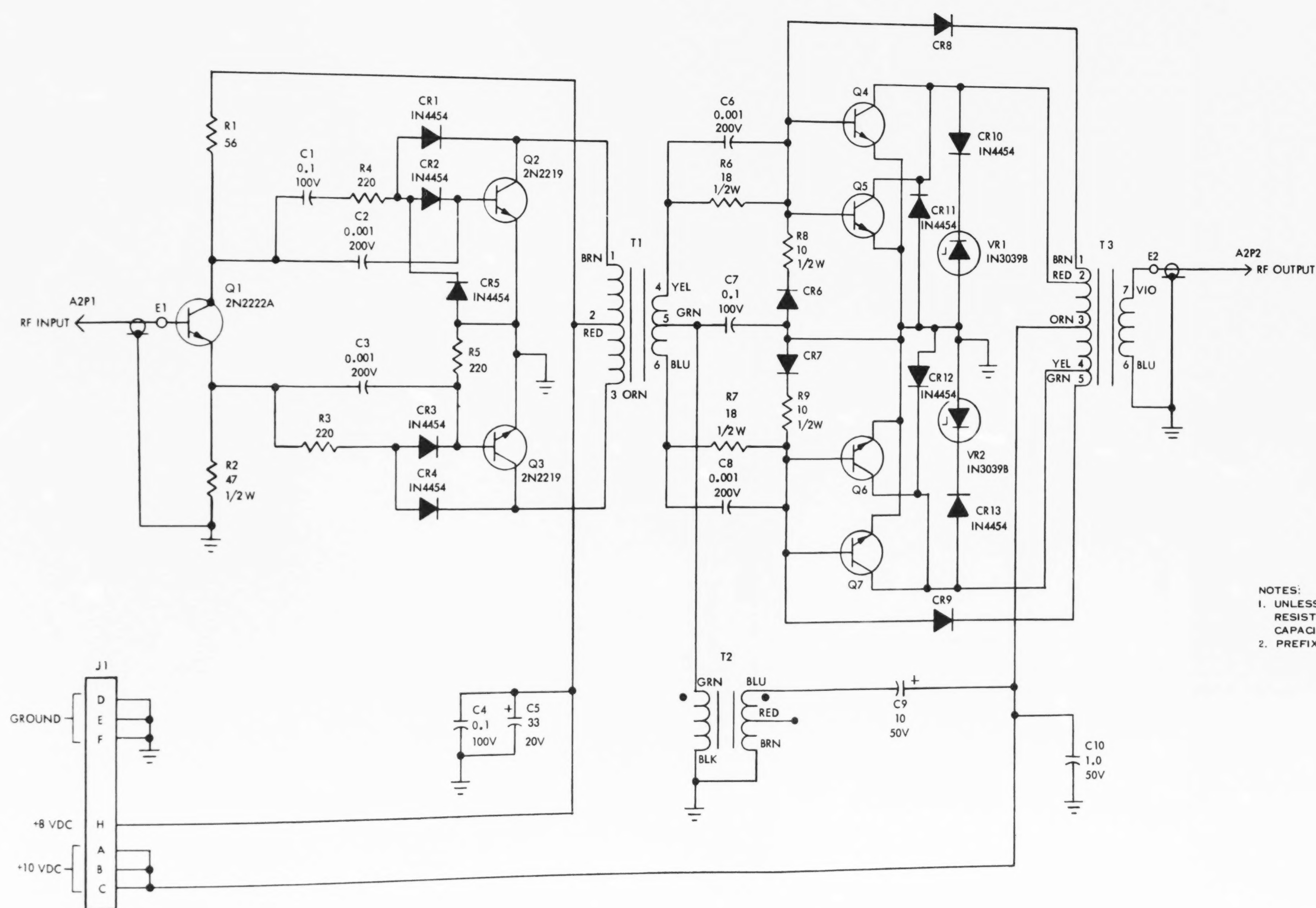


Figure FO-11. Encoder No. 2 1A9, Schematic Diagram.



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Figure FO-12. Rf Power Amplifier 1A2, Schematic Diagram.

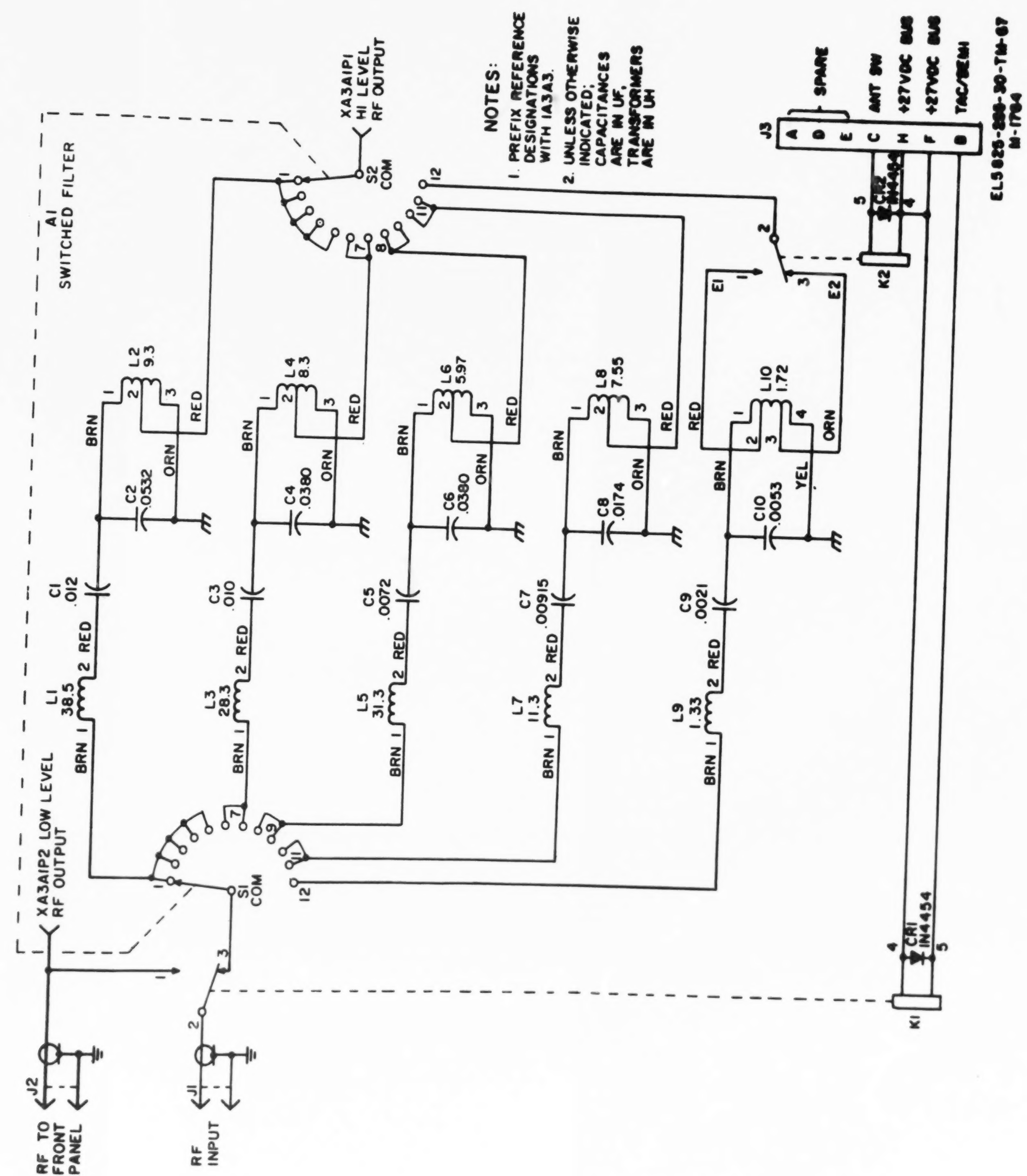


Figure FO-13. Transmitter Switched Filter 1A3A3, Schematic Diagram.

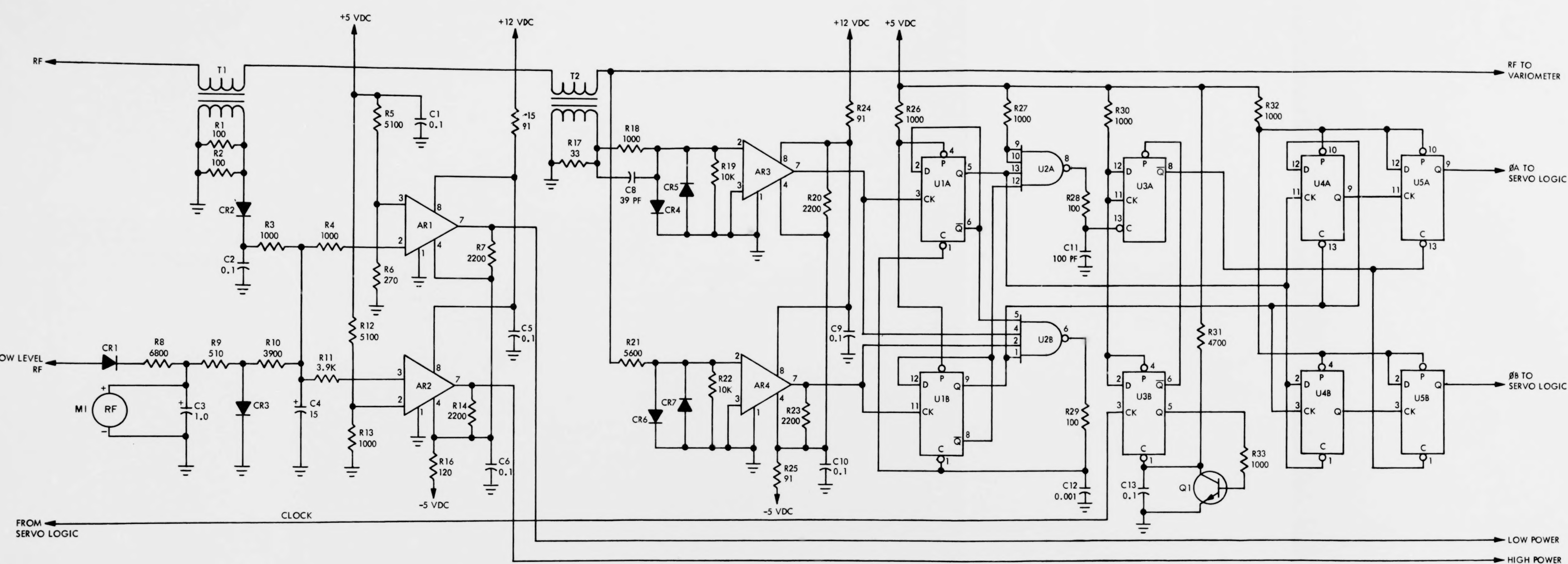
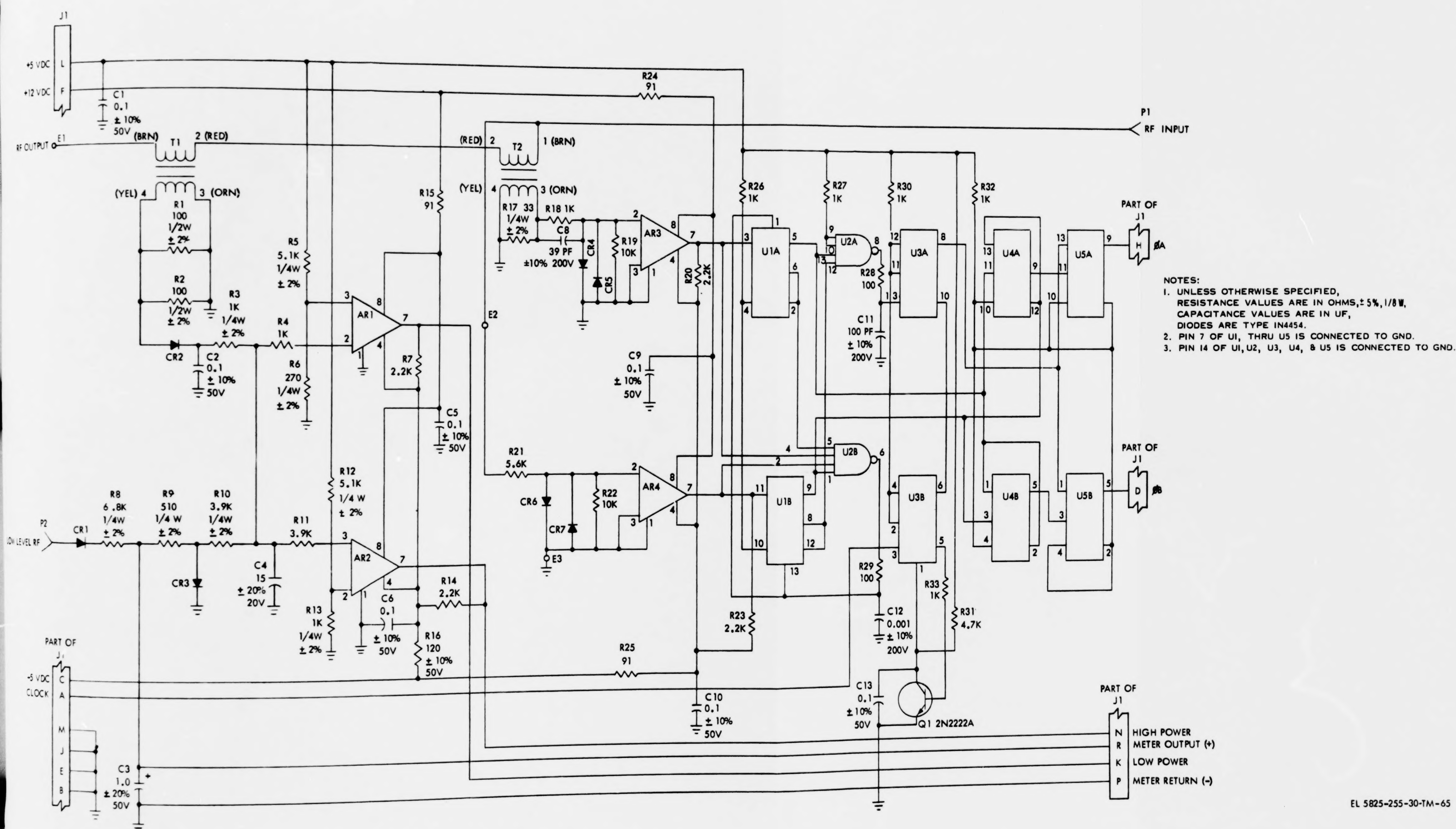


Figure FO-14. Power and Phase Detector Logic Diagram.



EL 5825-255-30-TM-65

M-1762

Figure FO-15. Detector 1A3A1, Schematic Diagram.

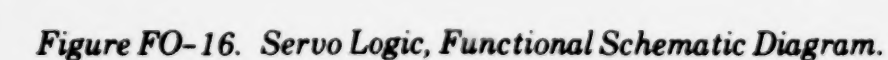


Figure FO-16. Servo Logic, Functional Schematic Diagram.

NOTE:

1. UNLESS OTHERWISE SPECIFIED, RESISTANCE VALUES ARE IN OHMS, 45%, 1/BW. CAPACITANCE VALUES ARE IN MICROFARADS, ±20%, 200V. TRANSISTORS ARE 2N2222A.
2. PREFIX REF DES WITH A11.
3. PIN 7 OF U1, U2, U3, U4, U5, U6, & U7 CONNECTED TO GROUND.
4. PIN 14, OF U1, U2, U3, U4, U5, U6, & U7 CONNECTED TO +5 VDC.
5. DESIGNATIONS INDICATE CONNECTIONS AT INTERCONNECT ASSY XA11P1, FIG. FO-3.
6. SELECT AT TEST FROM 4.7K TO 8.2K.

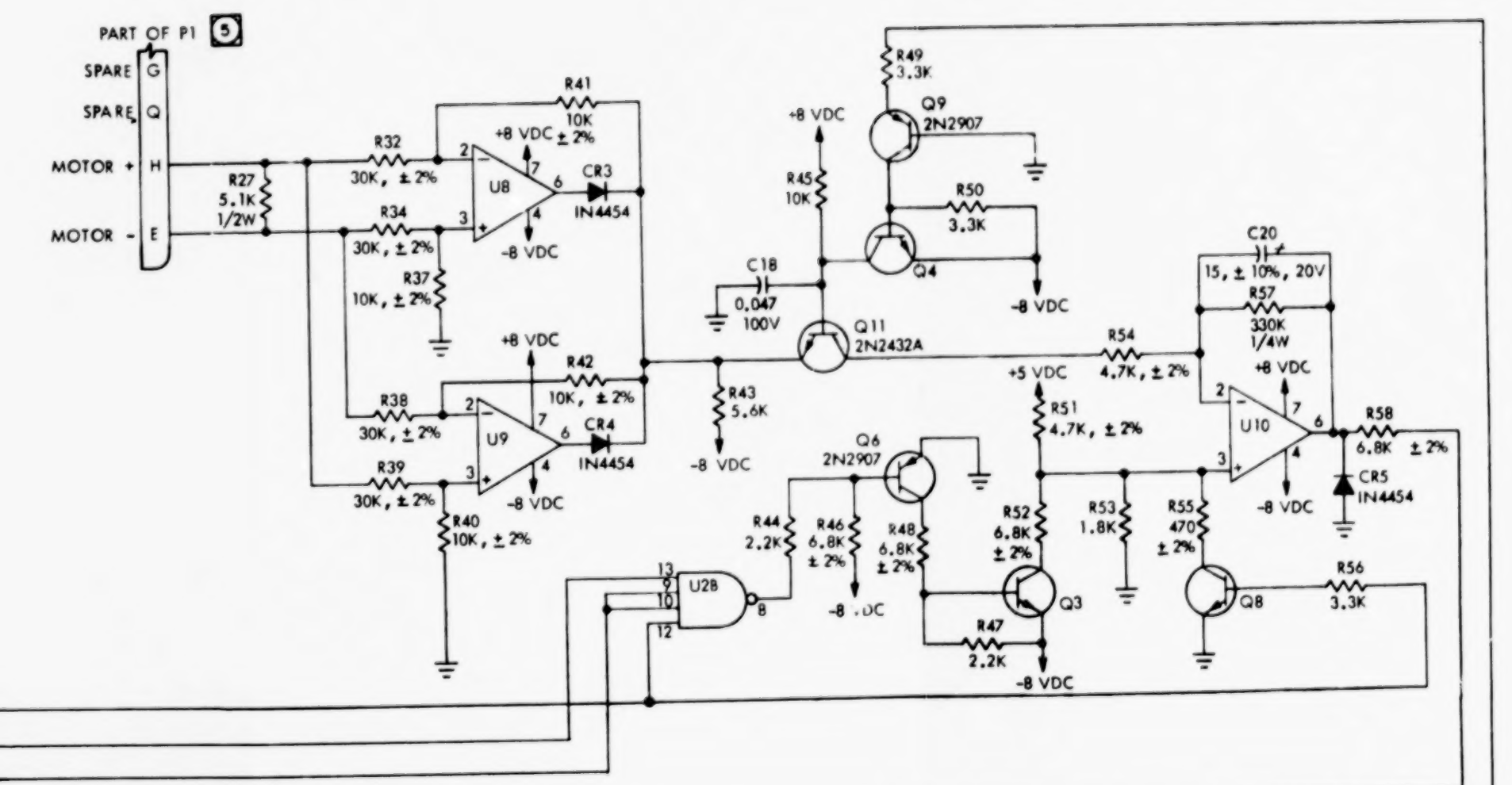
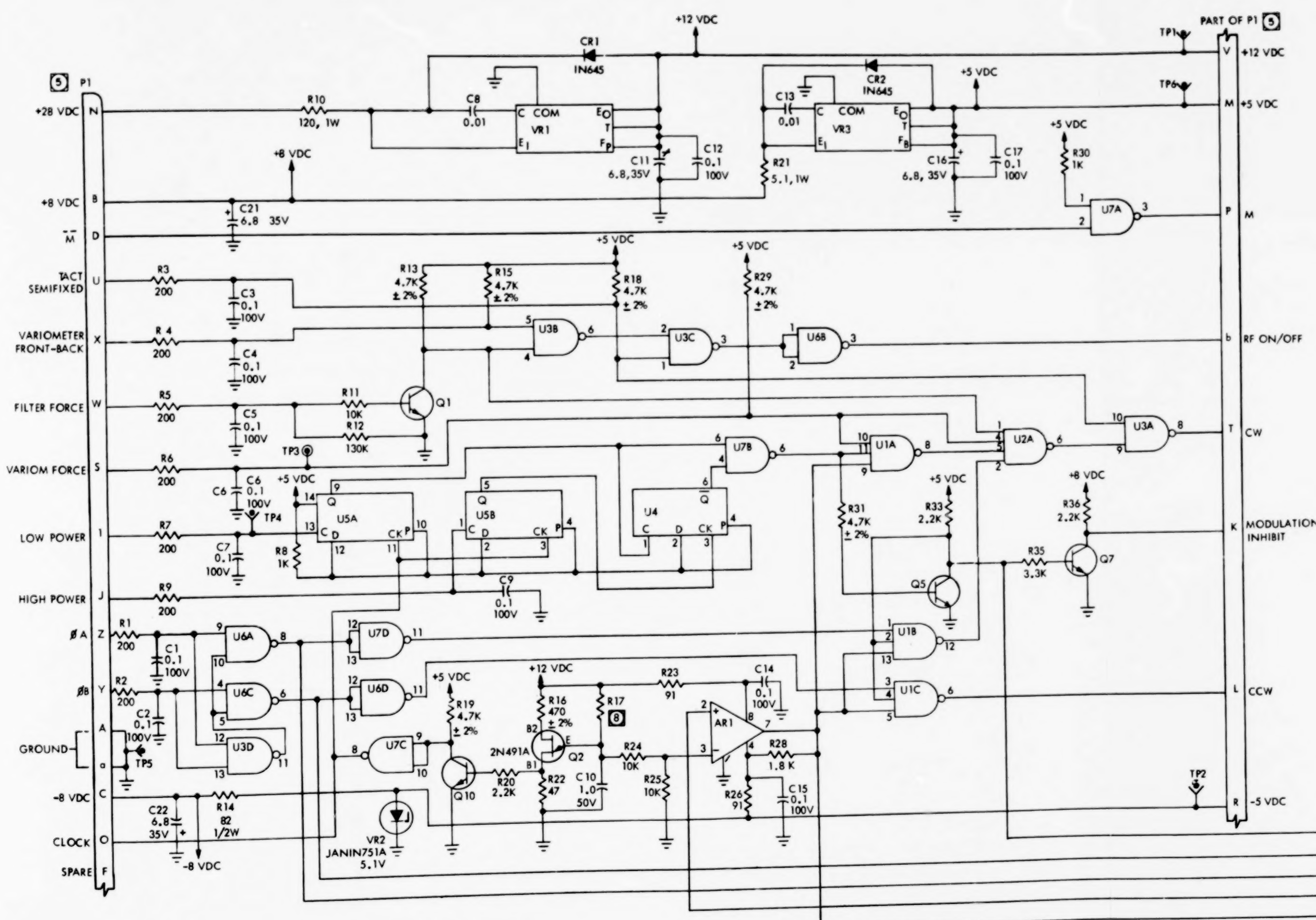


Figure FO-17. Servo Logic 1A11. Schematic Diagram.

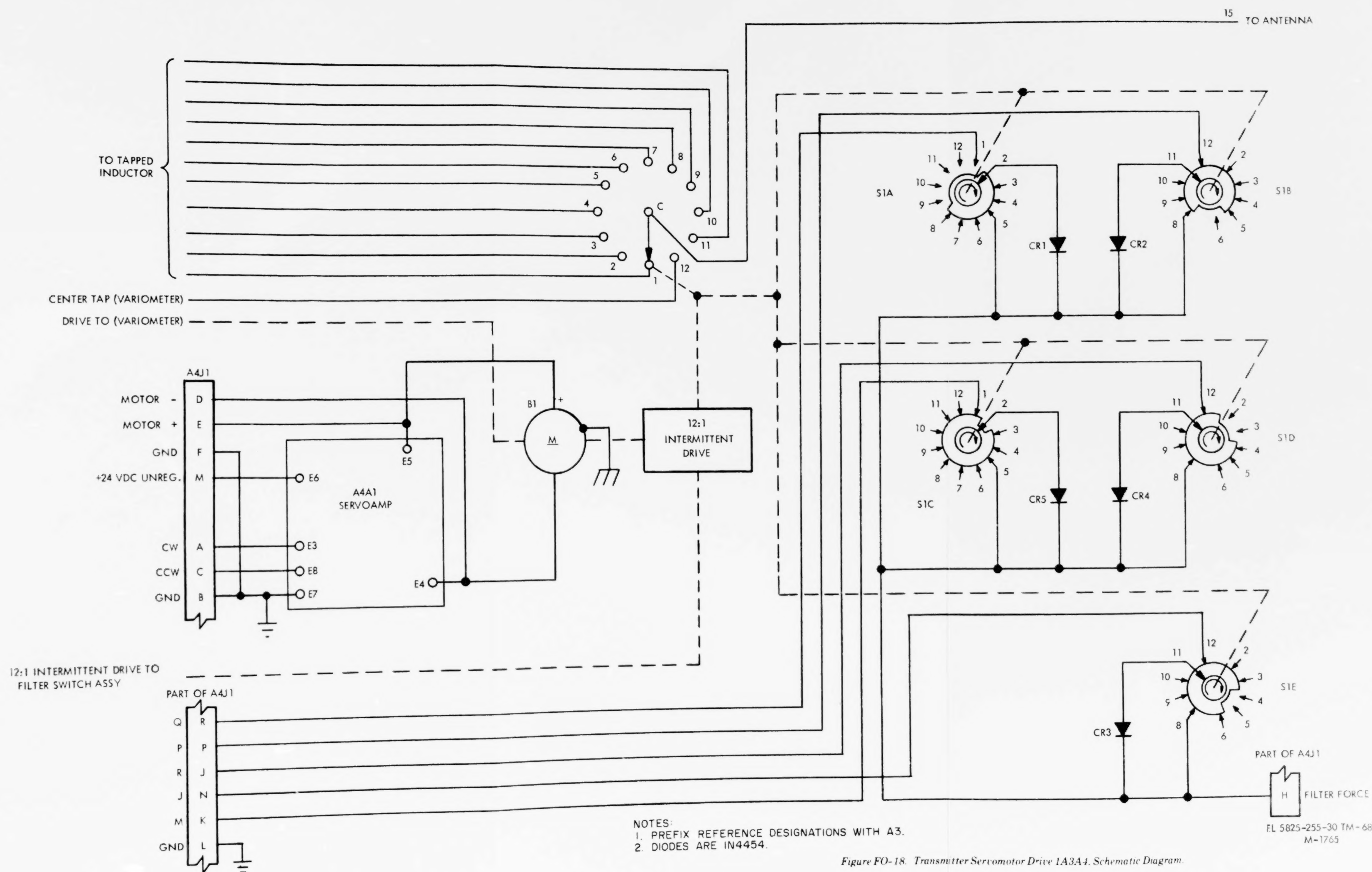
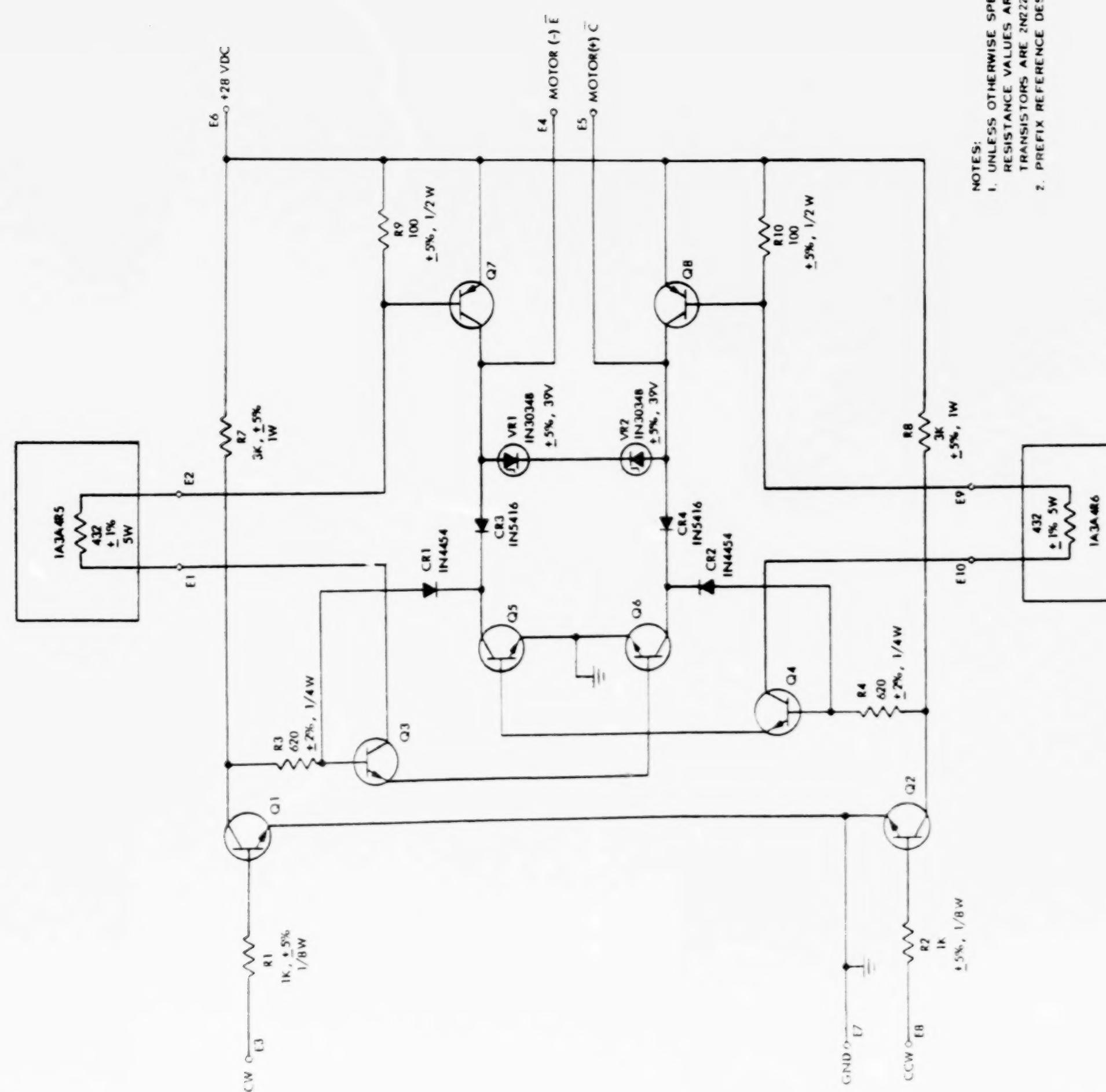


Figure FO-18. Transmitter Servomotor Drive 1A3A4. Schematic Diagram.



NOTES:
1. UNLESS OTHERWISE SPECIFIED,
RESISTORS ARE 5% TOLERANCE,
TRANSISTORS ARE 2N2222A,
2. PREFIX REFERENCE DESIGNATIONS WITH 1A3A4A1.

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Figure FO-19. Servoamplifier 1A3A4A1, Schematic Diagram.

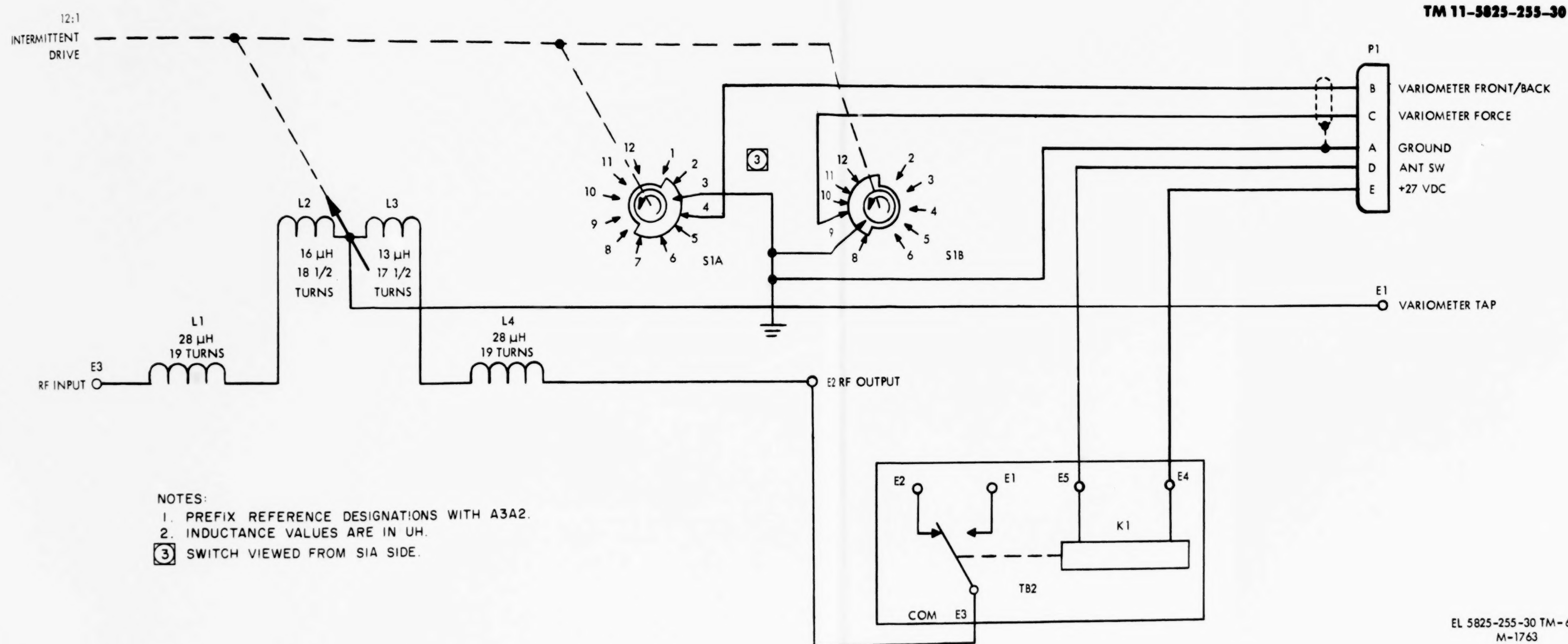


Figure FO-20. Variometer 1A3A2, Schematic Diagram.

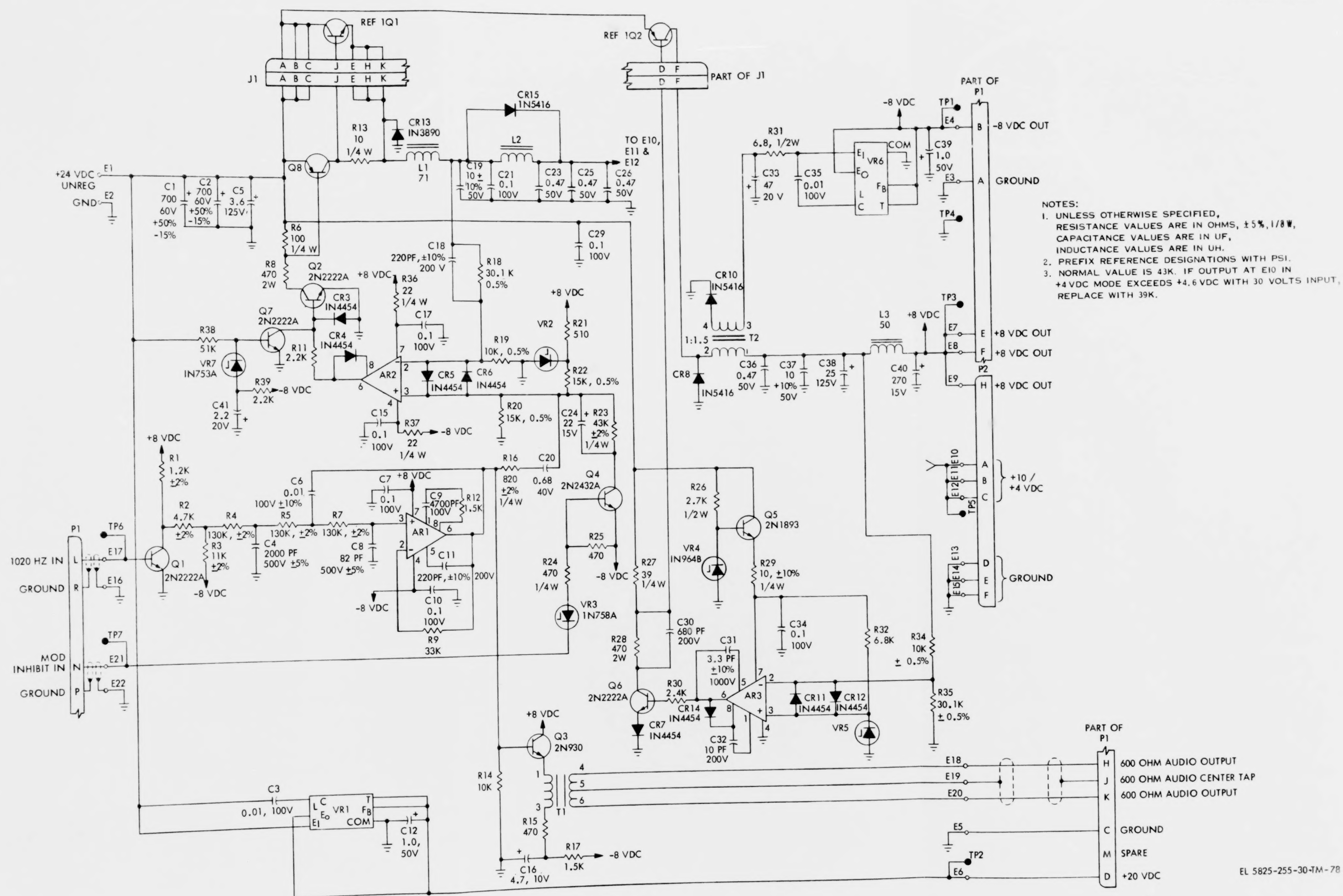


Figure FO-21. Transmitter Power Supplies 1PS1, Schematic Diagram.

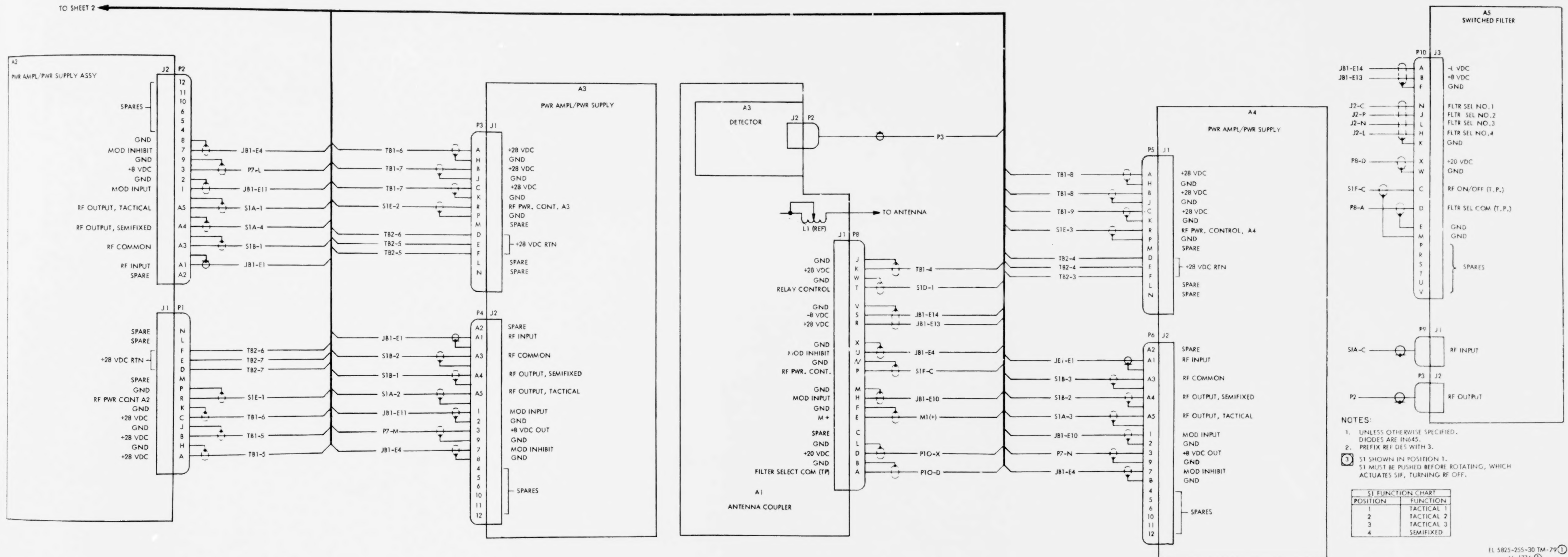
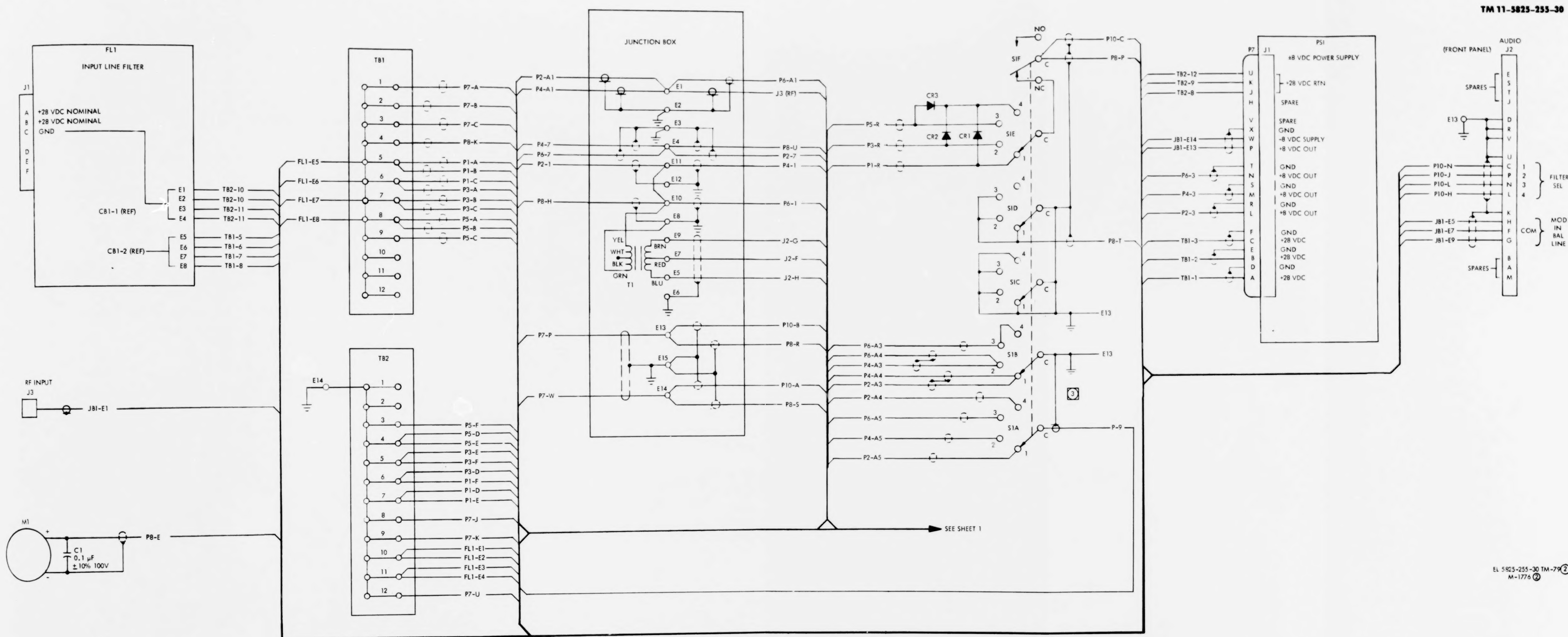


Figure PO-22. Amplifier Interconnect Diagram (sheet 1 of 2)



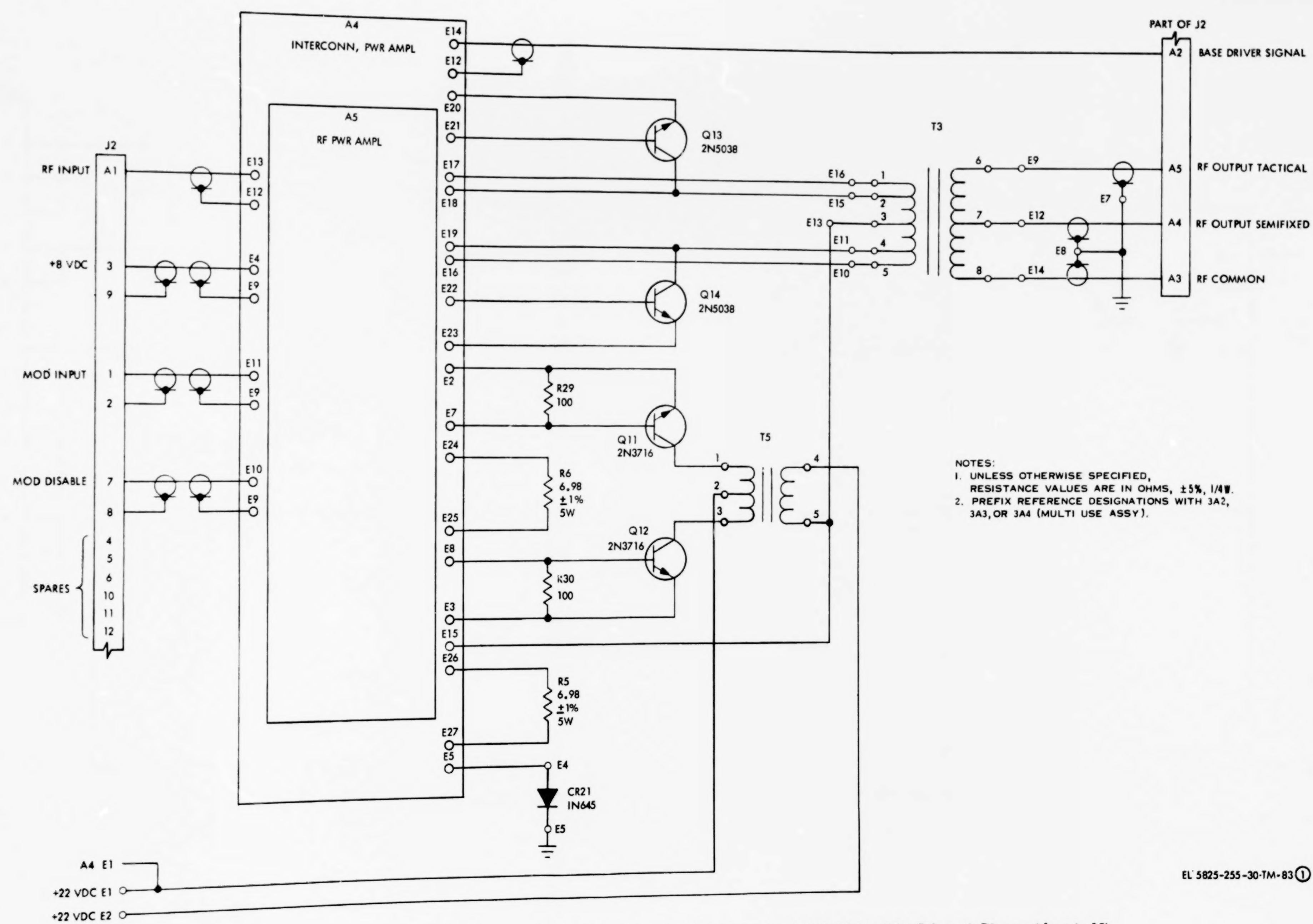


Figure FO-23. Power Amplifier-Power supply 3A2, 3A3, or 3A4, Schematic Diagram (sheet 1 of 2).

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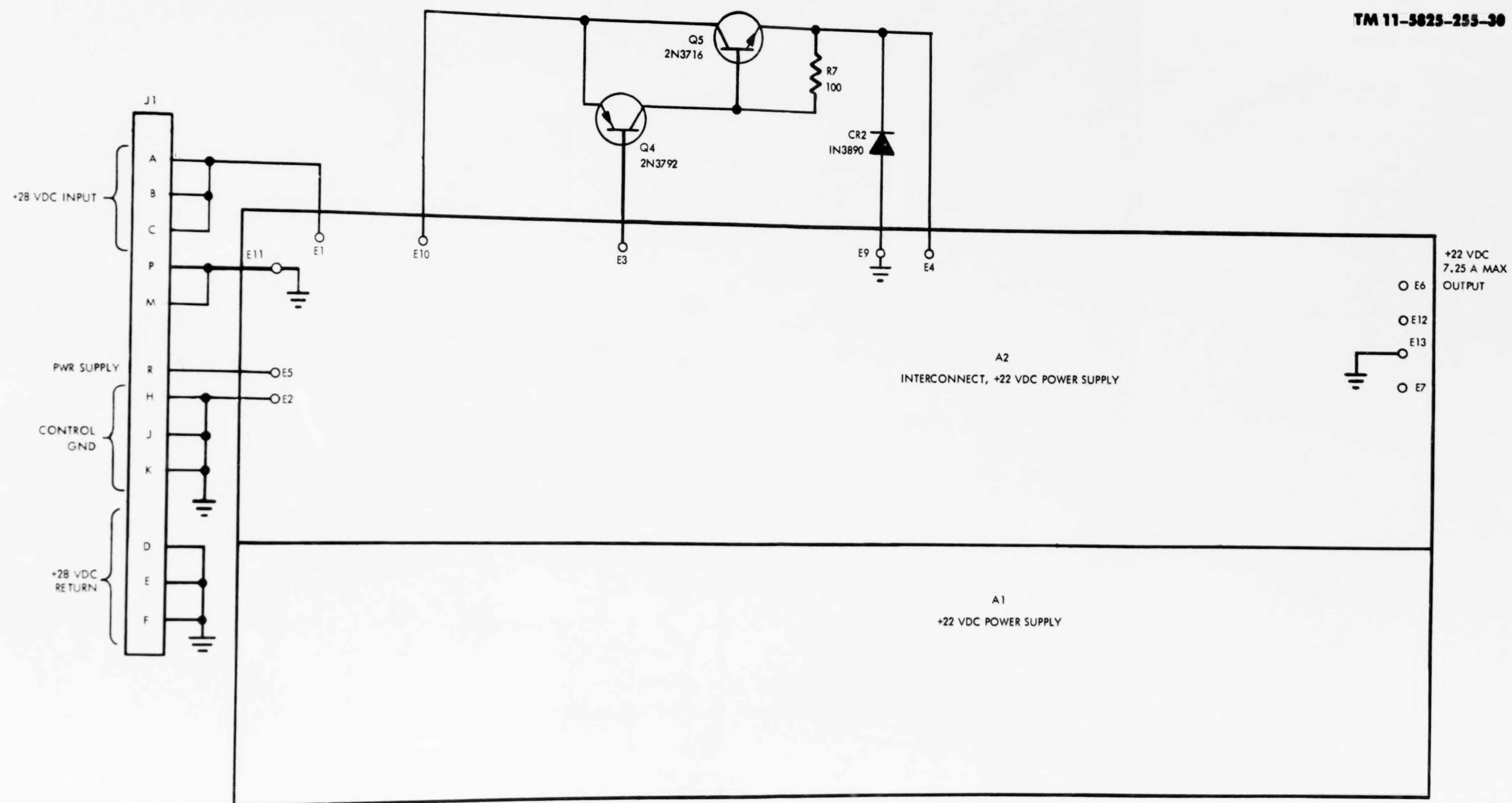


Figure FO-23. Power Amplifier-Power Supply 3A2, 3A3, or 3A4, Schematic Diagram (sheet 2 of 2).

EL 5825-255-30-TM-83 (2)

M-1780 (2)

TM 11-5825-255-30

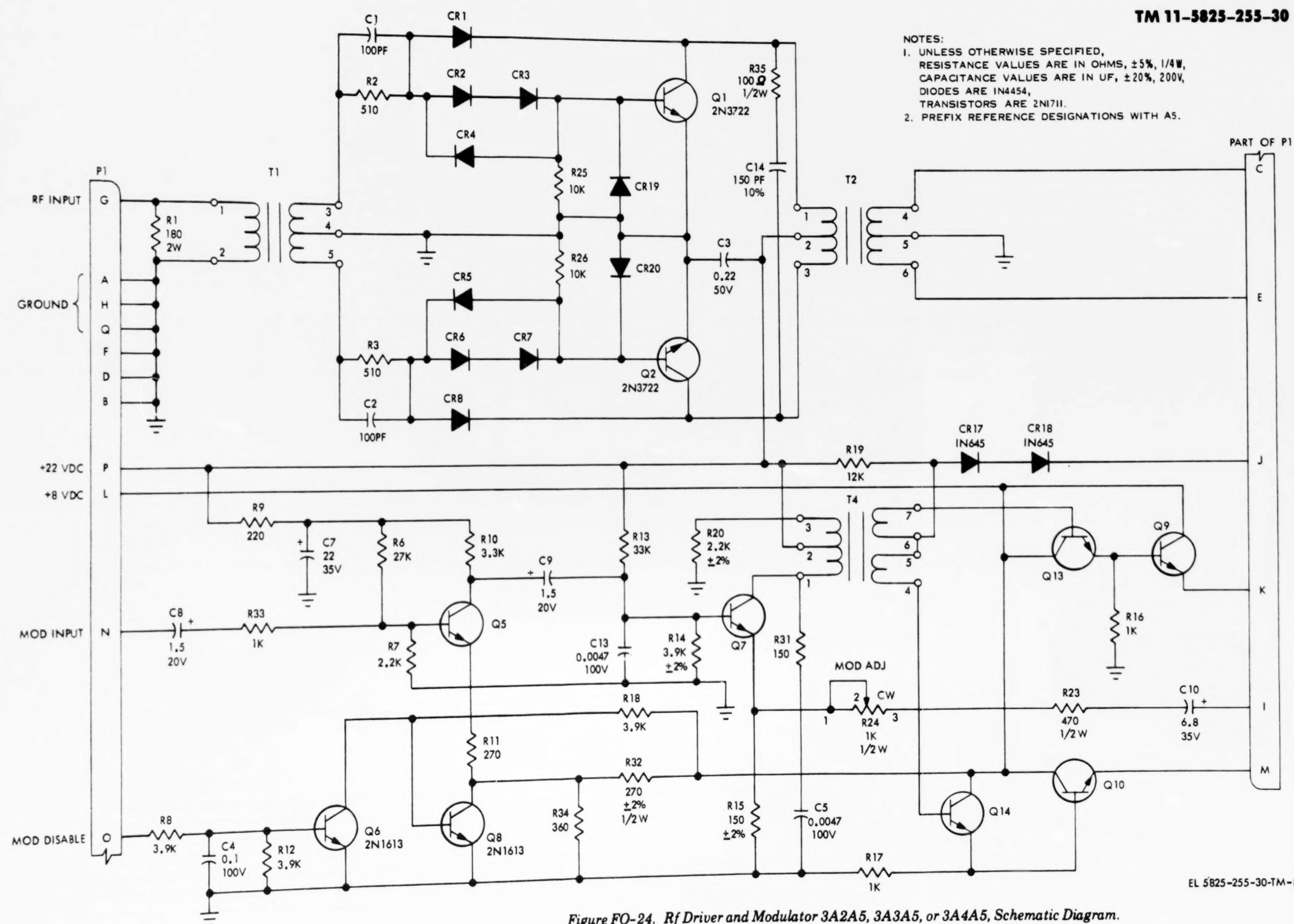
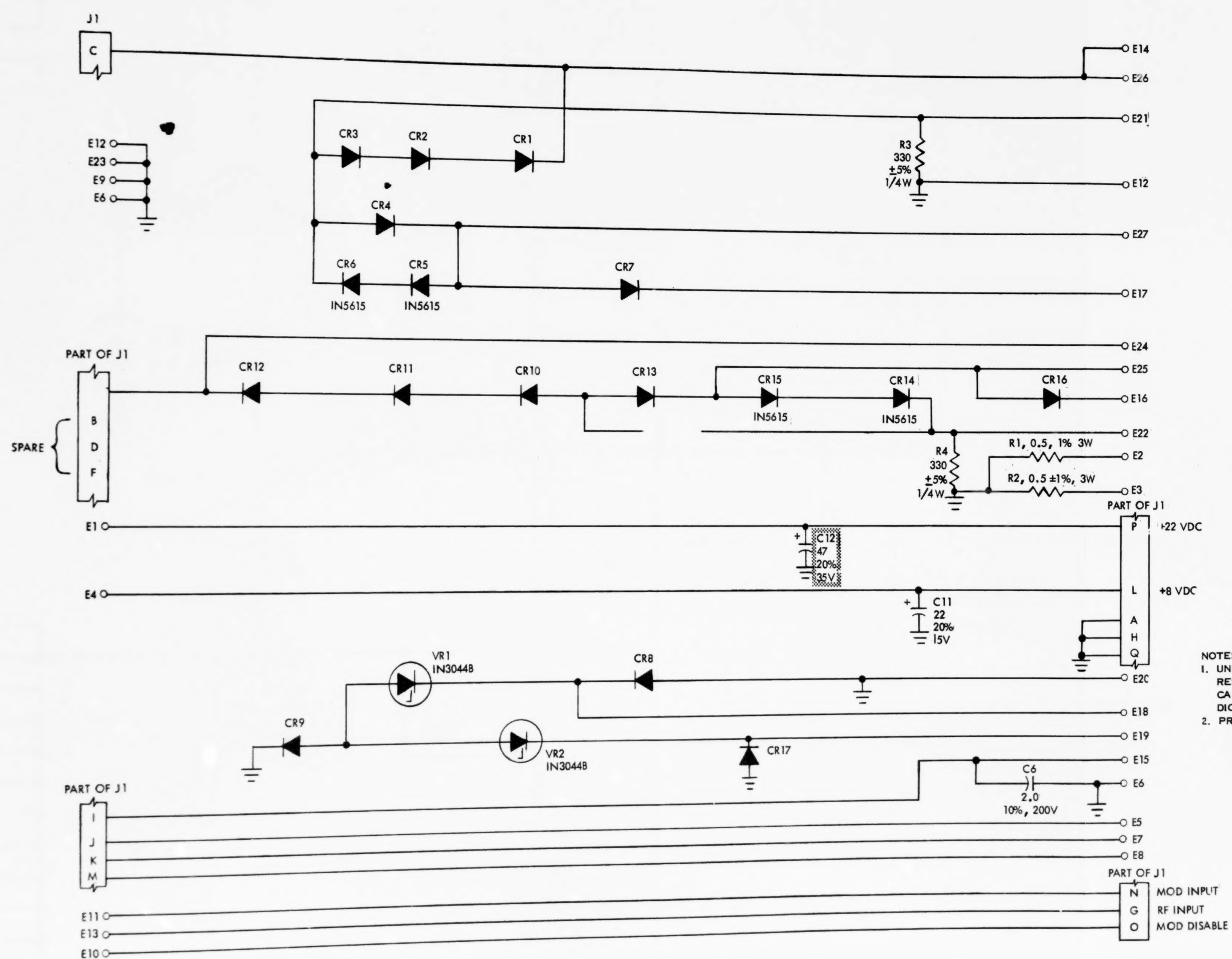


Figure FO-24. Rf Driver and Modulator 3A2A5, 3A3A5, or 3A4A5, Schematic Diagram.

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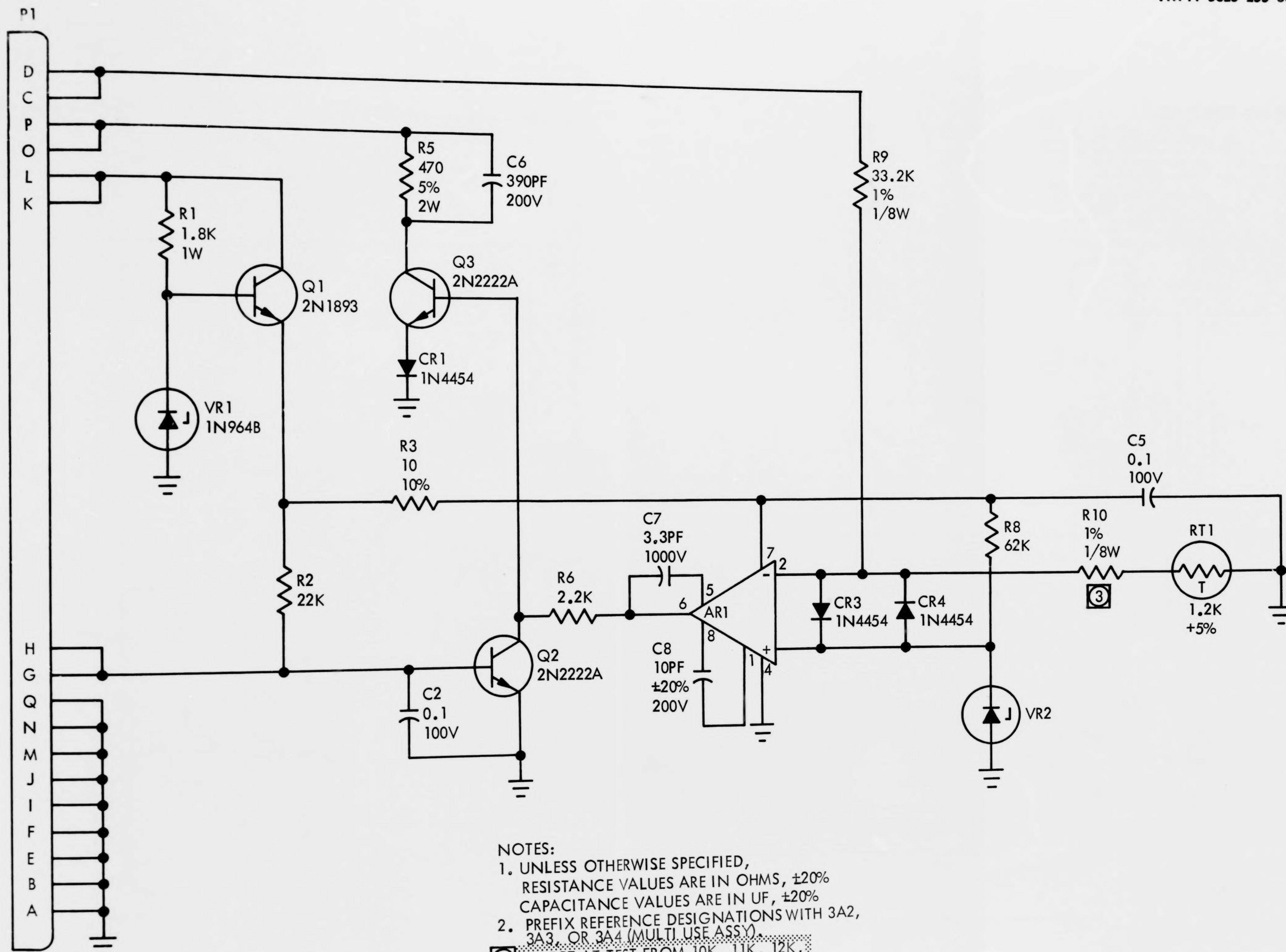
M-1784



NOTES:
1. UNLESS OTHERWISE SPECIFIED,
RESISTANCE VALUES ARE IN OHMS,
CAPACITANCE VALUES ARE IN UF,
DIODES ARE IN4454.
2. PREFIX REFERENCE DESIGNATIONS WITH A4.

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Figure FO-25. Rf Amplifier Interconnect 3A2A4, 3A3A4, and 3A4A4, Schematic Diagram.



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Figure FO-26. +22 Vdc Power Supply 3A2A1, 3A3A1, or 3A4A1, Schematic Diagram.

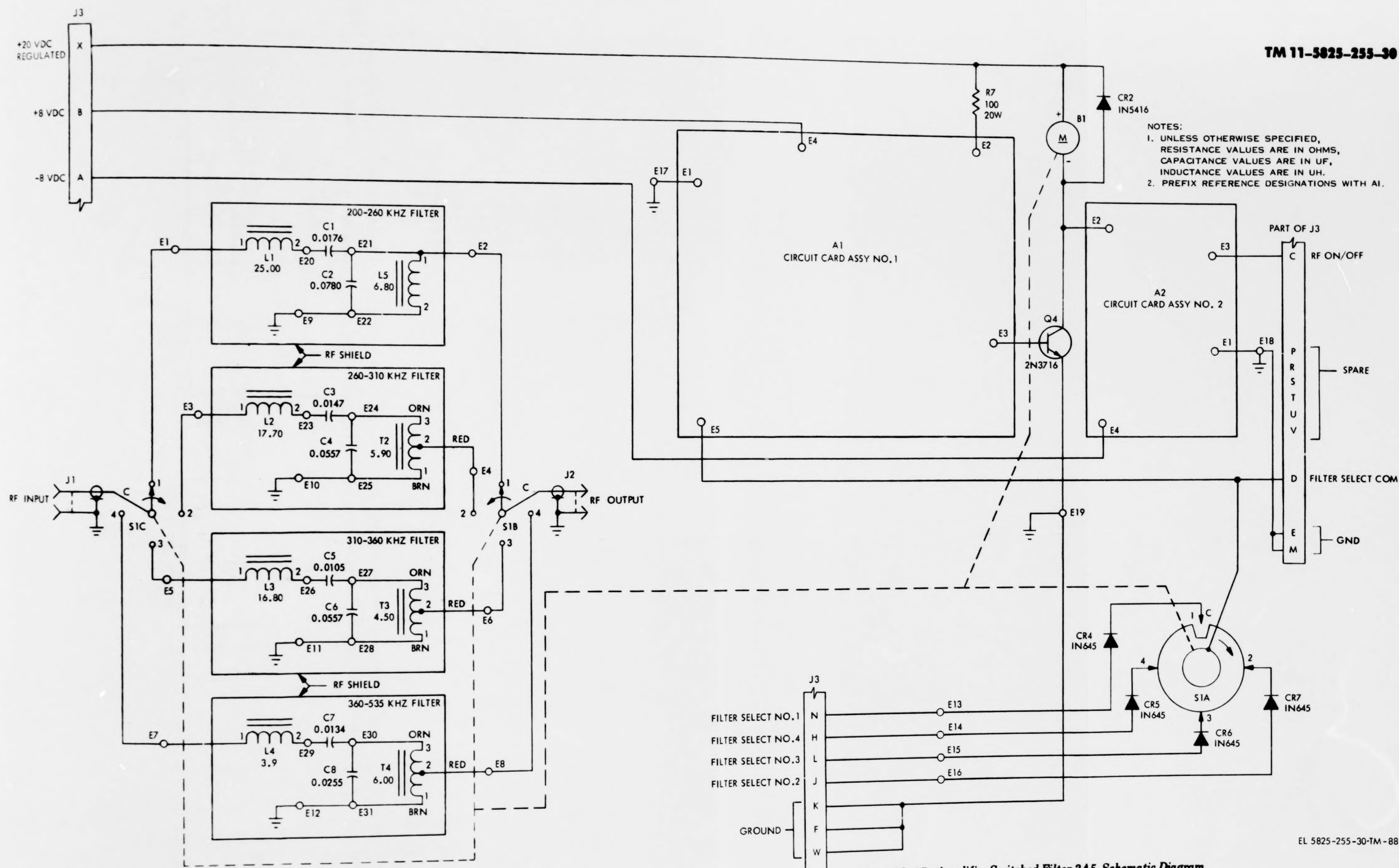
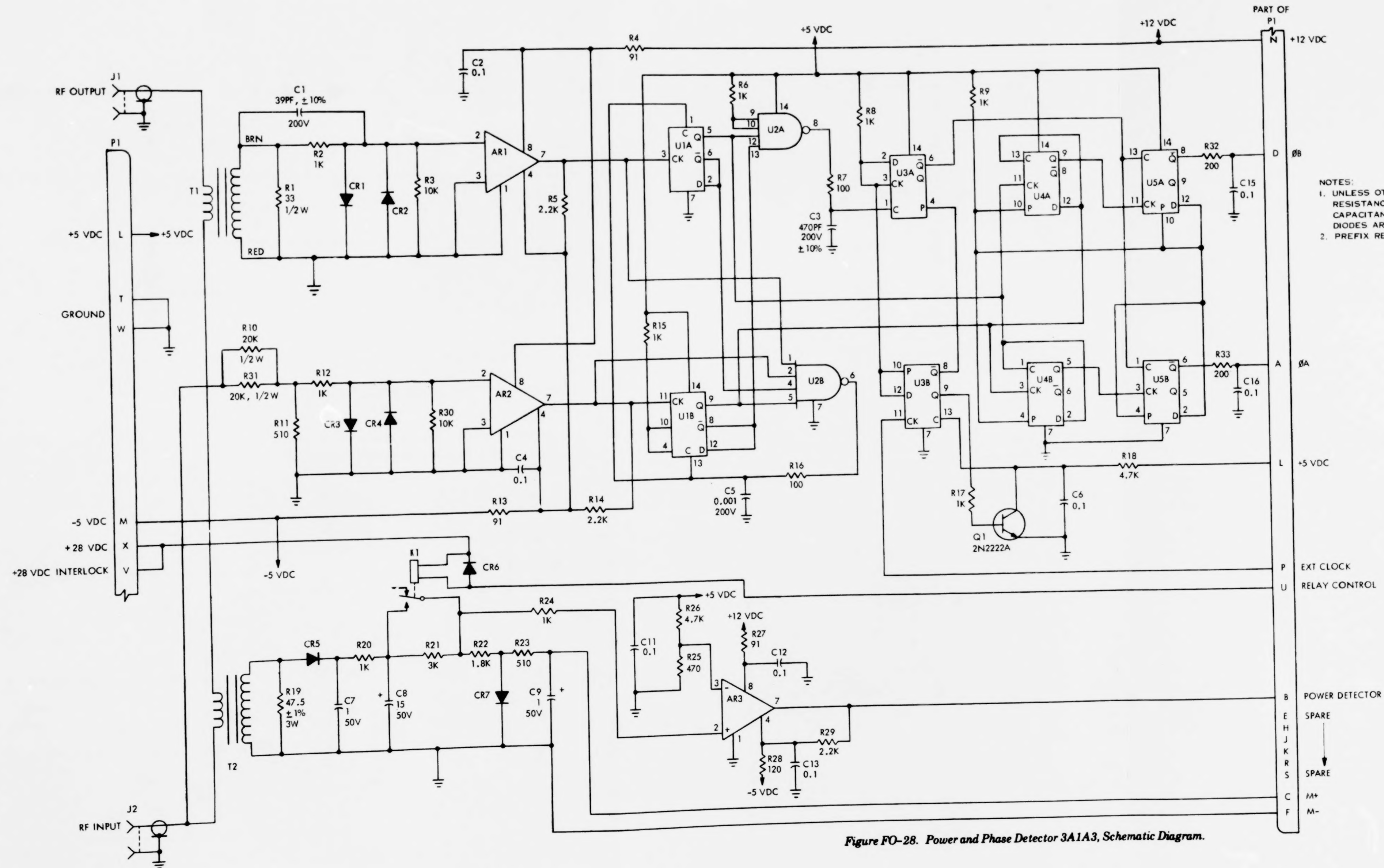


Figure FO-27. Amplifier Switched Filter 3A5, Schematic Diagram.

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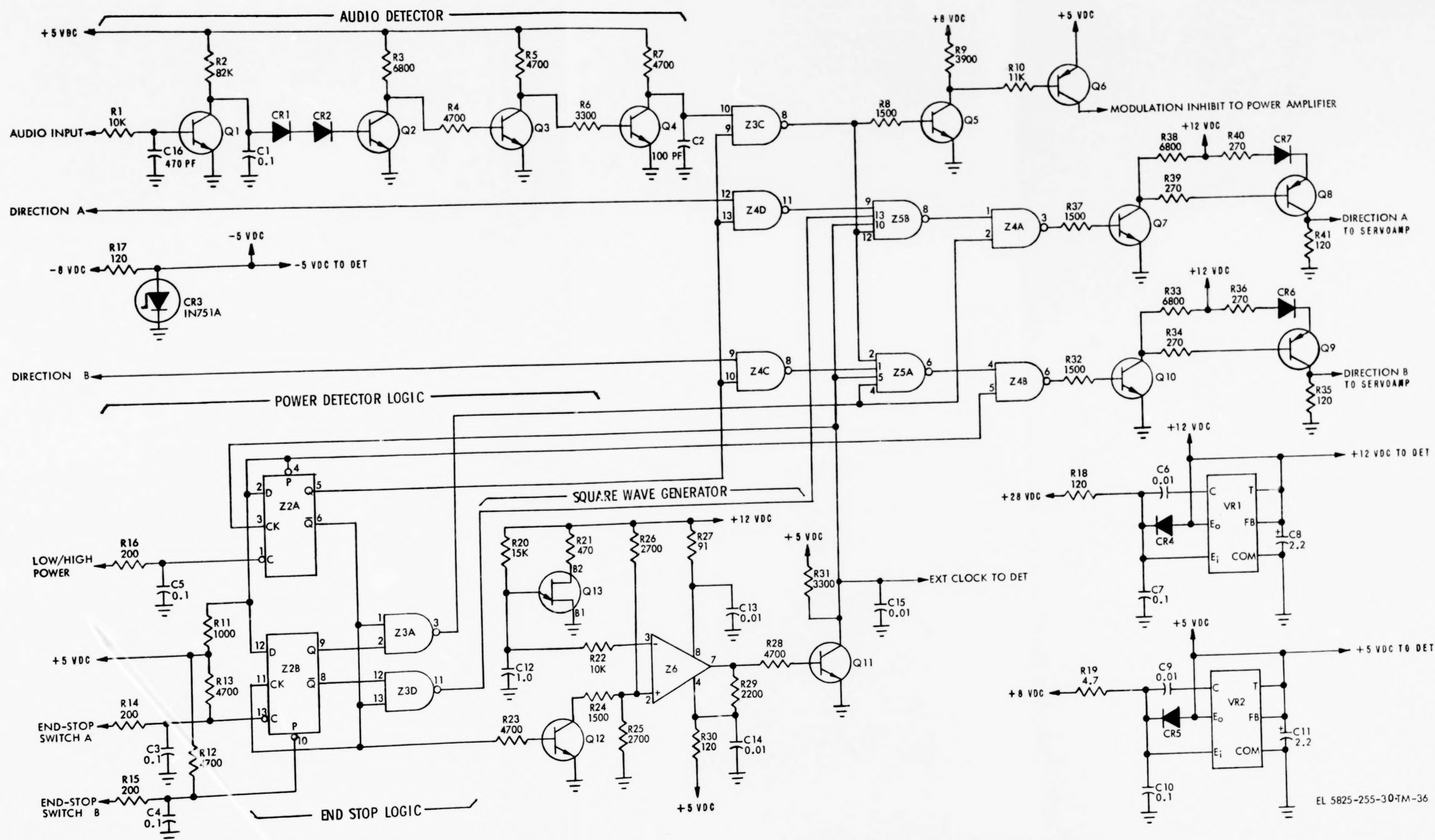
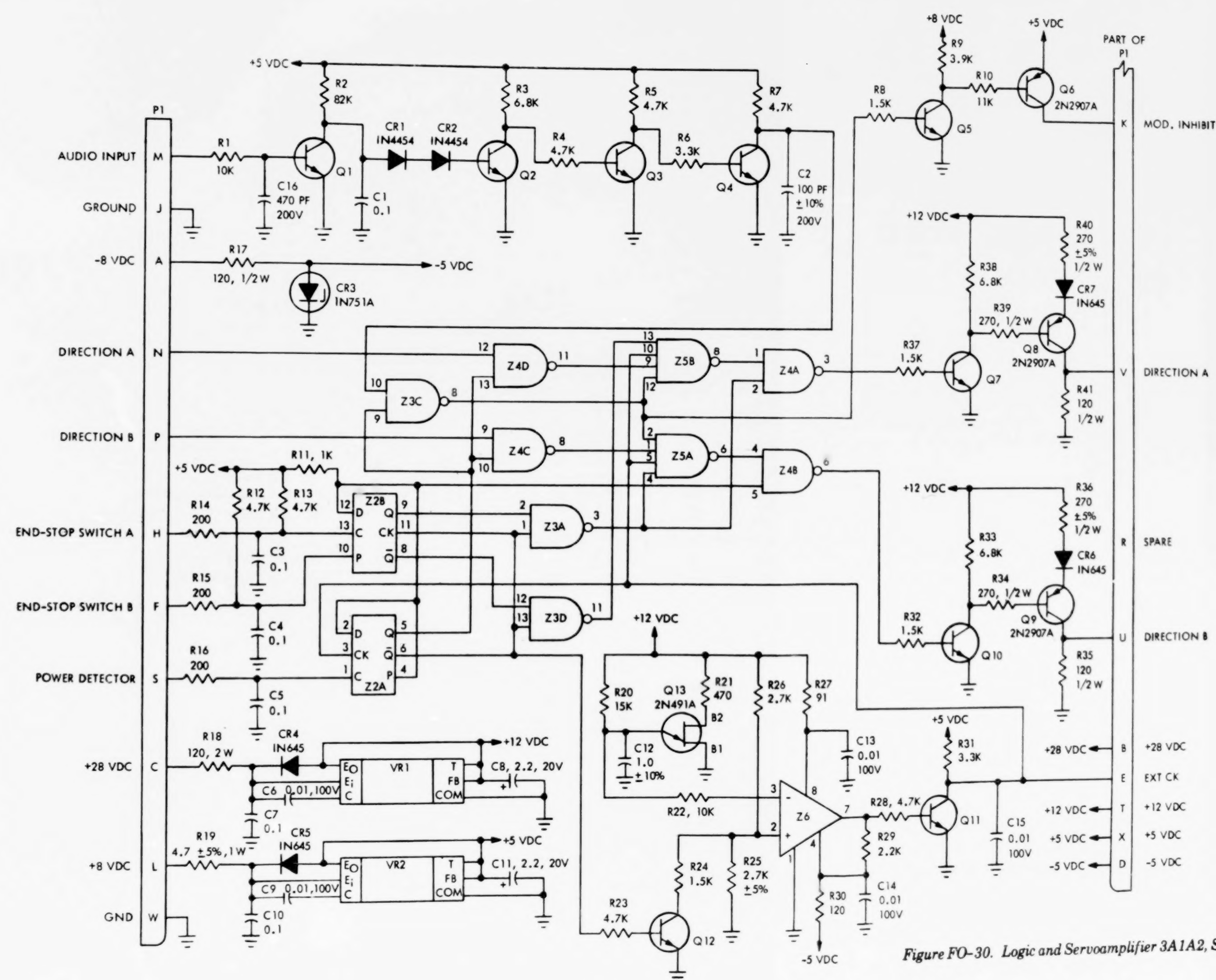


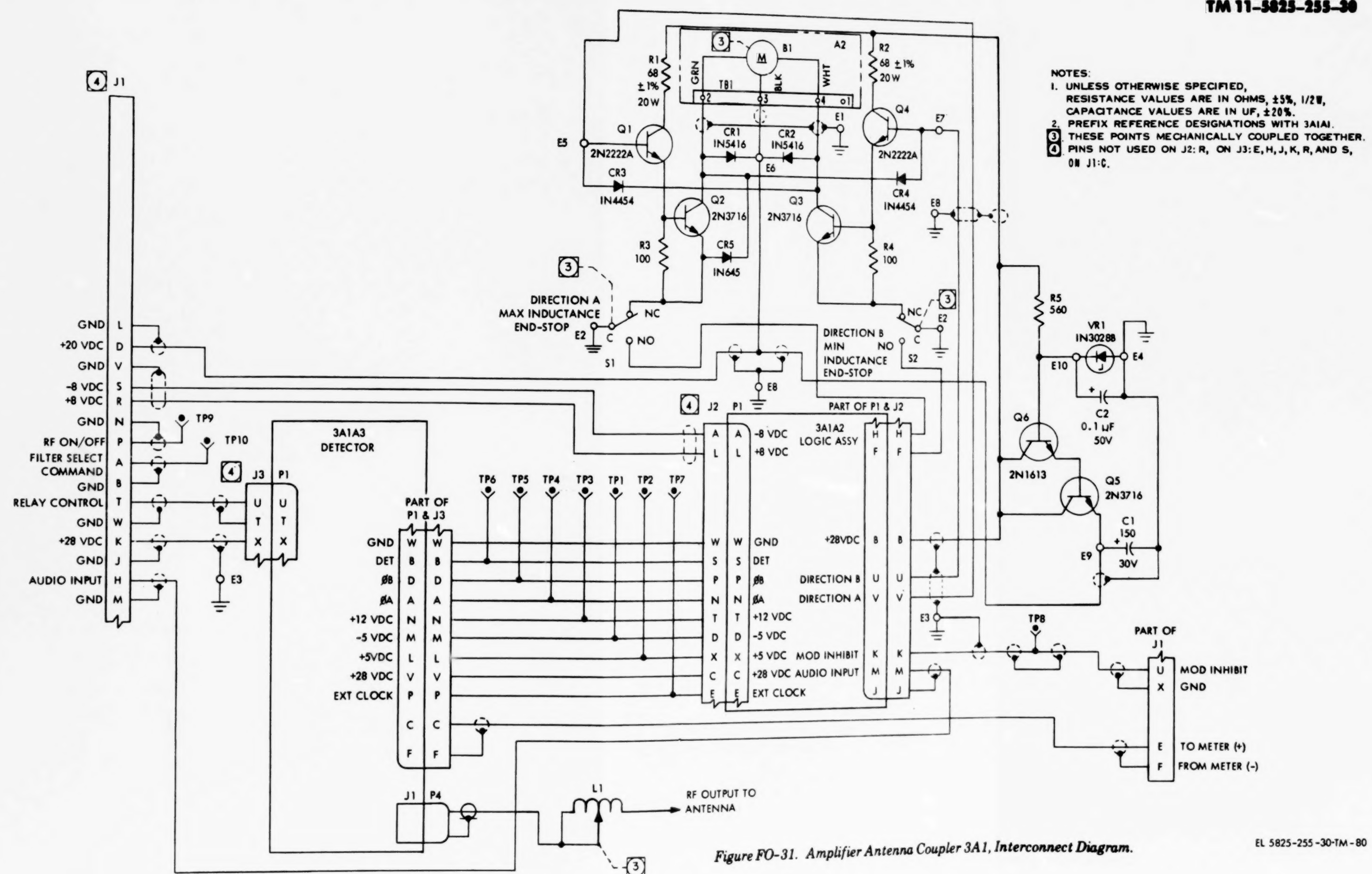
Figure FO-29. Logic and Servoamplifier, Functional Schematic Diagram.

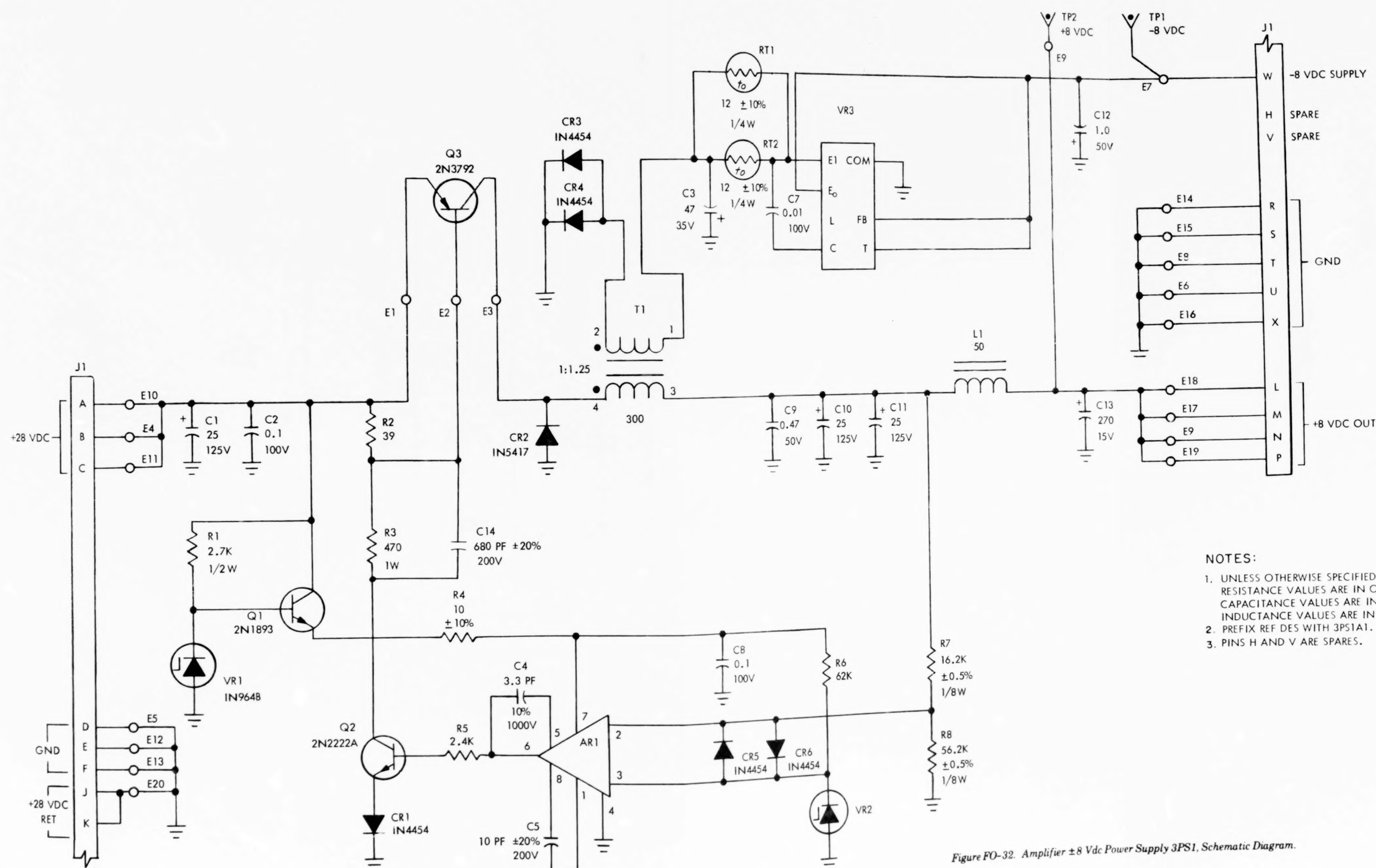


- NOTES:
1. UNLESS OTHERWISE SPECIFIED, RESISTANCE VALUES ARE IN OHMS, $\pm 2\%$, 1/4W, CAPACITANCE VALUES ARE IN UF, $\pm 20\%$, 50V, TRANSISTORS ARE 2N2222A.
 2. PREFIX REFERENCE DESIGNATIONS WITH 3A1A2.
 3. CONNECT PIN 14 OF Z2, Z3, Z4, AND Z5 TO -5V.
 4. AN UNUSED INPUT PIN 4 OF Z3, IS USED AS A FEED THRU ON CIRCUIT CARD.

Figure FO-30. Logic and Servoamplifier 3A1A2, Schematic Diagram.

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NOTES:

1. UNLESS OTHERWISE SPECIFIED.
RESISTANCE VALUES ARE IN OHMS, $\pm 5\%$, 1/4W.
CAPACITANCE VALUES ARE IN MICROFARADS, $\pm 20\%$.
INDUCTANCE VALUES ARE IN MICROHENRIES.
2. PREFIX REF DES WITH 3PS1A1.
3. PINS H AND V ARE SPARES.

Figure FO-32. Amplifier ±8 Vdc Power Supply 3PS1, Schematic Diagram.

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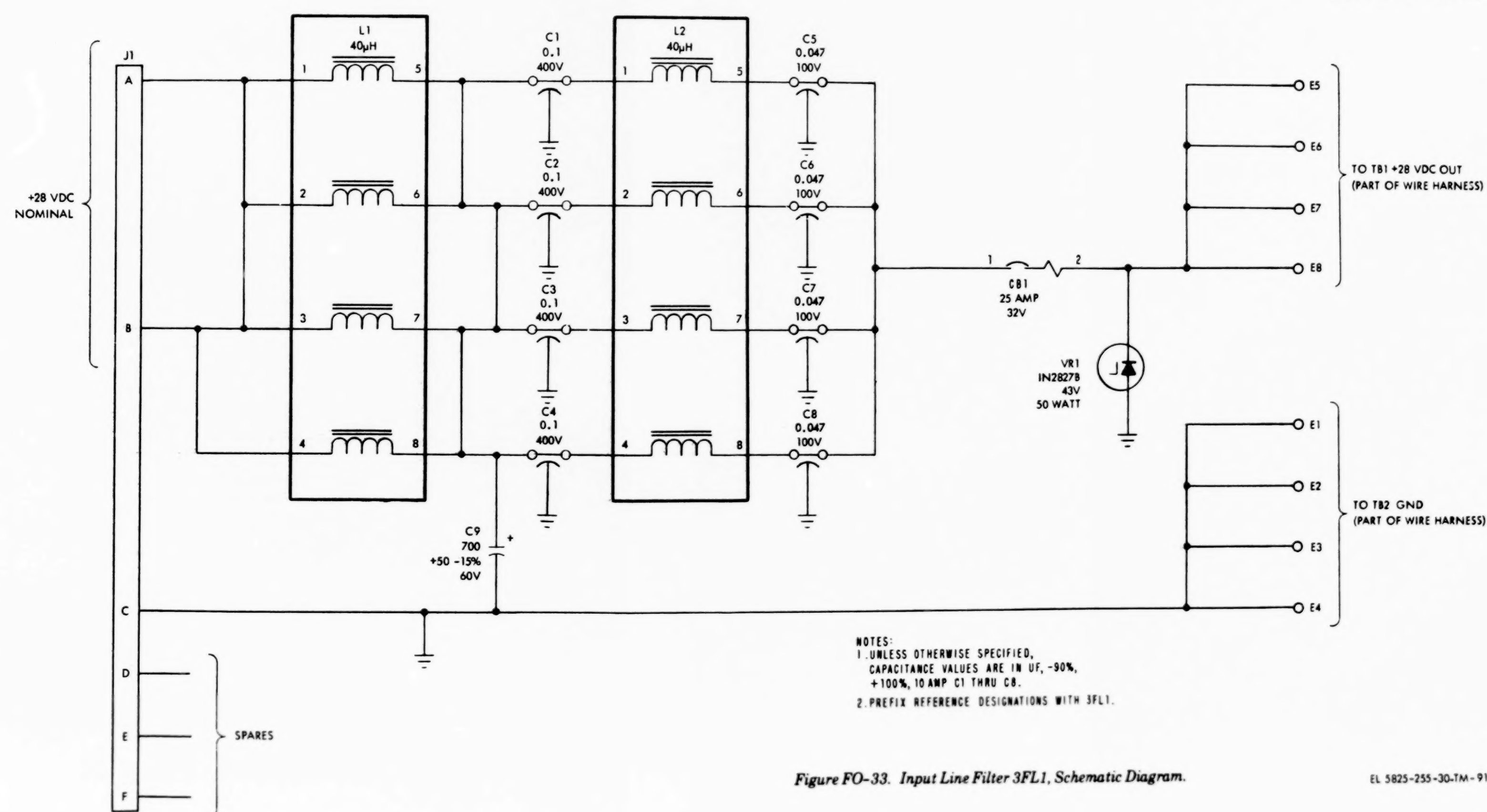


Figure FO-33. Input Line Filter 3FL1, Schematic Diagram.

EL 5825-255-30-TM-91

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